TRANSACTIONS

OF THE

NEW ENGLAND

WATER WORKS ASSOCIATION,

DURING THE YEAR

1884.

NEWTON:
PRESS OF THE NEWTON JOURNAL.
1885.

NEW ENGLAND WATER WORKS ASSOCIATION.

OFFICERS 1884–5.

President,

GEORGE A. ELLIS, Springfield, Mass.

Vice Presidents,

CHARLES K. WALKER, Manchester, N. H.
HORACE G. HOLDEN, Lowell, Mass.
ALVOID O. MILES, East Providence, R. I.
NATHANIEL I. JORDAN, Auburn, Me.
WALTER H. RICHARDS, New London, Ct.

Secretary,

ALBERT S. GLOVER, Newton, Mass.

Treasurer,

EDWIN DARLING, Pawtucket, R. I.

Executive Committee,

The above named officers with
HENRY W. ROGERS, Lawrence, Mass.
SHERMAN E. GRANNIS, New Haven, Ct.
FRANK E. HALL, Quincy, Mass.

Finance Committee,

JAMES H. HATHAWAY, New Bedford, Mass.
THOMAS B. LOVELL, Fitchburg, Mass.
J. HENRY BROWN, Boston, Mass.

The Fourth Annual Meeting of the Association will be holden at Springfield, Mass., on Thursday and Friday, June 18 and 19, 1885, at which meeting the following topics will be discussed:

1st. The Weight of Cast Iron Pipe for all sizes and pressures, as deduced from pipe in service; to be ascertained by correspondence and shown by diagram.

Opening paper by Albert F. Noyes, Esq., City Engineer of Newton, Mass.

2nd. The Necessity of Use of Tank for supplying Water Closets, Hot Water Boilers, etc.

Opening paper by William R. Billings, Esq., Supt. Water Works, Taunton, Mass.

3d. The Necessity and Method of Flushing Street Mains.

Opening paper by J. Henry Brown, Esq., Supt. Mystic Division, Boston Water Works.

4th. Street Mains. Relative merits of the different kinds in use.

Opening paper by Frank E. Hall, Esq., Supt. Water Works, Quincy, Mass.

5th. Uniformity in the Preparation of Water Works Reports.

Opening papers by William R. Billings, Esq., Supt. Water Works, Taunton, Mass., and Robert C. P. Coggeshall, Esq., Supt. Water Works, New Bedford, Mass.

PREAMBLE, CONSTITUTION AND BY LAWS.

PREAMBLE.

We, the undersigned, desirous of forming an Association for the exchange of information pertaining to the management of "Water Works" for the mutual benefit of consumers and "Water Companies" and for the purpose of securing economy and uniformity in the operation of Water Works, do hereby associate ourselves and adopt the following :—

CONSTITUTION AND BY-LAWS.

ARTICLE I.

NAME AND OBJECTS.

SECTION 1. The name of the Association shall be "The New England Water Works Association."

SECT. 2. The object of this Association shall be the promotion and advancement of knowledge, scientific and practical, in all matters relating to the construction and management of "Water Works" and the distribution and consumption of water, the establishment and maintenance of a spirit of "fraternity" between the members of the Association by social intercourse, and by friendly interchange of information and ideas on the before-mentioned subjects.

ARTICLE II.

SECT. 1. The members of this Association shall consist of two classes. Active members and Fine members.

SECT. 2. To be eligible as an Active member, a person must be a Superintendent, Registrar, Secretary, Treasurer or Engineer of a Water company.

SECT. 3. Active members shall pay an initiation fee of five dollars, and shall pay the sum of two dollars annually thereafter, which sum shall be paid in advance.

SECT. 4. No member whose annual payment shall be in arrears one year shall be entitled to vote or participate in the deliberations of the Association.

SECT. 5. Any member may retire from membership by giving written notice of his desire to the Secretary and by the payment of all annual dues to that date, but he shall remain a member and be liable to the payment of annual dues till such payments are made.

SECT. 6. A member may be expelled from the Association after due notice to him by a report and motion to that effect made by the executive committee at a general meeting of the Association. The vote shall be by ballot and shall require two-thirds of the votes cast for its adoption.

ARTICLE III.

FINE MEMBERS.

SECT. 1. Persons or firms engaged in furnishing materials for the construction and maintenance of Water Works desiring to join the Association may be admitted as members by the usual form on the payment of ten dollars and be entitled to one representative at each meeting, who shall not be entitled to vote, but may take part in any discussion, if permission is given by the meeting.

ARTICLE IV.

SECT. 1. All candidates for membership shall be proposed by a member of the executive committee and notice thereof shall be given by the Secretary to the Association for its action. The election of an applicant for membership shall be by ballot and each person shall receive two-thirds of the number of ballots cast to be elected.

SECT. 2. If any application for membership on being balloted for be rejected, no notice shall be taken of the application or record of the same be made in the minutes, and the admission fee shall be returned.

SECT. 3. New members shall be formally introduced to the Association by the presiding officer, after being elected; they shall subscribe their names to the Constitution of the Association, in a roll-book of the same, and they shall each at the same time receive a copy of the Constitution and By-Laws of the Association.

ARTICLE V.

OFFICERS.

SECT. 1. The officers shall consist of a President, five Vice Presidents, Secretary and Treasurer, to be elected annually by ballot.

SECT. 2. The officers of the Association, with three other members who shall be elected for that purpose, shall constitute the Executive Committee.

SECT. 3. A Finance Committee, consisting of three members of the Association, shall be chosen.

All officers shall serve for one year, or until their successors are elected.

ARTICLE VI.

DUTIES.

SECT. 1. The President shall preside at all meetings, or in case of his absence the senior Vice President present shall preside.

SECT. 2. The affairs of the Association shall be managed by the Executive Committee, subject to control of the Association by its action in general meeting. All questions in Executive Committee shall be decided by majority vote and five members shall be a quorum.

The Executive Committee shall have control of the property and management of the affairs of the Association, shall provide suitable rooms for all annual and other meetings and shall have power to expend the funds of the Association; *provided*, that no indebtedness shall be incurred in excess of the funds in the hands of the Treasurer. All papers read at meetings of the Association must relate to matters connected with the objects of the Association, and must be approved by the Executive Committee before being read, and they shall also suggest topics for discussion.

SECT. 3. The Secretary shall keep the records of all meetings, conduct all correspondence, receipt for all fees and dues, and pay to the Treasurer all money received, taking his receipt therefor. In addition to these duties he shall read minutes and also papers and communications, if the authors desire it, and discharge such other duties as may be required by the Constitution and By-Laws appertaining to his department. He shall have such compensation for his services as the Executive Committee may determine.

SECT. 4. It shall be the duty of the Treasurer to receive from the Secretary all moneys for the Association, to keep correct account of all receipts and expenditures, and to pay all demands against the Association when approved by the President. At the annual meeting he shall exhibit a statement of his accounts and shall give such bonds as may be required by the Executive Committee.

SECT. 5. The Finance Committee shall meet on the day of the Annual Meeting of the Association, at least one hour before the

opening of the meeting, to receive from the Treasurer a statement of his account and to audit the same. They shall hold such other meetings as the interest of the Association may require.

SECT. 6. The officers of the Association shall assume office immediately after the close of the meeting at which they have been elected. They shall hold meetings at the call of the President, or, in the absence of the President, at the call of the senior Vice President.

ARTICLE VII.

SECT. 1. The Annual Meeting of the Association shall be held on the third Thursday in June, in each year, at 10 o'clock A. M., at such place as shall be determined by the Association at the previous annual meeting. Other general meetings of the Association may be held at such times and places as shall be directed at the previous meeting.

SECT. 2. At any Regular Meeting of the Association, ten members shall be a quorum for the transaction of business.

SECT. 3. The Secretary shall send a notice to all members of the Association at least fourteen days before each General Meeting.

SECT. 4. Questions shall be decided by any convenient form of voting, the presiding officer to have the casting vote when necessary. Questions of special nature shall be decided by ballot, if demanded.

ARTICLE VIII.

SECT. 1. Any member of a Water Board or Board of Water Commissioners or Board of Trustees of any Water Works is cordially invited to be present at any meeting of the Association as Honorary Member. Any member, with the concurrence of the presiding officer, may admit a friend at each meeting of the Association, but such person shall not take part in any discussion unless permission to do so be given by the meeting.

SECT. 2. All papers, drawings or models submitted to the meetings of the Association, shall be and remain the property of the authors.

SECT. 3. All propositions for adding to, or altering any of the provisions of the foregoing Constitution, shall be submitted to the Executive Committee, who may bring it before the next meeting of the Association, and shall do so on the written request of any five members of the Association, and if two-thirds of the members present shall vote in favor of such alteration or amendment it shall be adopted.

ORDER OF BUSINESS.

At the Annual Meeting of the Association the order of business shall be:—

First. The reading of the minutes of the last meeting.

Second. The reading of applications, notices, and reports for new membership.

Third. The election and introduction of new members.

Fourth. The address of the President.

Fifth. Report of the Executive Committee on the management of the Association for the previous year.

Sixth. The report of the Treasurer.

Seventh. The report of the Finance Committee.

Eighth. The report of Special Committees.

Ninth. The Election of Officers.

Tenth. The Reading of Papers of which notice has been given and Discussion upon the same.

Eleventh. General Business.

At other General Meetings of the Association the Order of Business shall be the same, except as to the 5th, 6th, 7th and 9th clauses.

PROCEEDINGS AT THE THIRD ANNUAL MEETING.

St. Charles Hotel, Lowell, Mass.,
Thursday and Friday, June 19 and 20, 1884.

The convention was called to order at 10 o'clock A. M., by President Frank E. Hall, of Quincy, who extended a brief welcome to all present, and announced that the convention was open for business.

Upon motion of Mr. Billings, of Taunton, *voted* that the reading of the records of the last meeting be dispensed with.

The favorable report of the Executive Committee upon the following applications for membership was presented by the President:

FOR ACTIVE MEMBERSHIP.

Daniel Russell,	Everett, Mass.
John C. Chase,	Wilmington, N. C.
Marshall Mason,	St. Albans, Vt.
A. H. Howland,	Indian Orchard, Mass.
J. A. Brand,	Norwich, Conn.
B. S. Grush,	Salem, Mass.
Gilbert Murdock,	St. John, N. B.
W. S. Barbour,	Cambridge, Mass.
George E. Batchelder,	Worcester, Mass.
A. B. Fitts,	Attleboro, Mass.
Lucian A. Taylor,	Worcester, Mass.

FOR FINE MEMBERSHIP.

R. D. Wood & Co., ... Philadelphia, Pa.
Marshall T. Davidson, . . . Brooklyn, N. Y.
Henry R. Worthington, ... New York.

Upon motion of Mr. Horan, of Clinton, the Secretary was instructed to cast one ballot for the entire list of applicants. The motion prevailed, and Secretary Coggeshall formally cast the ballot, as instructed.

The next business in order was the reading of the address of the President.

THE PRESIDENT'S ADDRESS.

Gentlemen of the New England Water Works Association: —

We have met for the third time in annual convention to review the labors of the past year, consider the business affairs of the association and arrange our plans for the future.

Our record for the past year is to-day made a part of history and we have reason to refer to it with pride. The reports of the Secretary and Treasurer give the usual detailed statements and show an increase of membership, and the financial affairs of the association to be in good condition.

Two meetings have been held, one annual and one special, with an increasing interest each time. The receptions given us and attention shown us where it has been our privilege to meet, by those interested in a system of public water supply, are conclusive evidence of their interest in our prosperity, and a desire to assist us in our efforts to obtain knowledge, and should stimulate us to renewed efforts to advance our mutual interests.

We know that among a large number of individuals there will be a diversity of opinion; this is natural and right, and when controlled by reason, with a due regard for

the wishes and interests of others, will assist in forming conclusions and developing results that will prove of benefit to the community.

The is some difference of opinion as to the best time in the year for holding the annual meeting of the association. I presume no time that may be selected will be alike convenient for all to attend, but I trust that the good judgment and reason of the association will as in the past do what may be for the interest of all. We all have our own affairs to attend to and often conclude we cannot leave our business to attend a meeting like this; but I hope all will agree with me in this, that all who do attend will be better fitted for their duties after our meetings than before. I hope the month of June will be the time for our annual meeting in the future and that the plan of having a fall meeting or "Field Day" will be continued. In the spring we arrange our plans of operation and commence our work, and perhaps at this time may gain ideas that may be of benefit to us; and as many of us are interested with work of great magnitude it is pleasant near the close of our labors to meet and compare notes and results as we now do in an informal way.

You are all aware that the next annual meeting of the American Water Works Association is to be held in Boston, commencing April 15, 1885, and if any action is considered advisable by this association the present seems a favorable time for its consideration.

While we may feel that we have reason for congratulation upon our success thus far, we must not forget that we owe a duty to the public; that much will be expected of us, and that to merit the continued support and co-operation of those whose interests we serve, already so cheerfully given, we must make and maintain a high standard of excellence

for ourselves and try to extend the usefulness of our association beyond the limits of New England.

The roll was next called, and the following members were found to be present:

ACTIVE MEMBERS.

WILLIAM R. BILLINGS, Superintendent, . . Taunton, Mass.
J. HENRY BROWN, Supt. Charlestown Dist., . . Boston, Mass.
JONAS M. CLARK, Superintendent, . . Northampton, Mass.
ROBERT C. P. COGGESHALL, Superintendent, . New Bedford, Mass.
EDWIN DARLING, Superintendent, . . . Pawtucket, R. I.
NATHANIEL DENNETT, Superintendent, . . Somerville, Mass.
GEO. A. ELLIS, Supt. and Registrar, . . . Springfield, Mass.
ALBERT S. GLOVER, Registrar, ... Newton, Mass.
ROBERT M. GOW, Superintendent, ... Medford, Mass.
SHERMAN E. GRANNIS, Superintendent, . . New Haven, Conn.
FRANK E. HALL, Superintendent, ... Quincy, Mass.
WARD W. HAWKES, Superintendent, . . . Malden, Mass.
THOMAS A. HODGE, Superintendent, . . . No. Adams, Mass.
HORACE G. HOLDEN, Superintendent, . . . Lowell, Mass.
DAVID W. HORAN, Superintendent, ... Clinton, Mass.
HORATIO N. HYDE, Jr., Superintendent, . . Newton, Mass.
HORACE H. KNAPP, Clerk, ... Lowell, Mass.
ADDISON LANE, Superintendent, ... Melrose, Mass.
THOMAS C. LOVELL, Superintendent, . . . Fitchburg, Mass.
JAMES W. LYON, Commissioner, ... Lynn, Mass.
ALVOID O. MILES, Superintendent, . . East Providence, R. I.
HIRAM NEVONS, Superintendent, . . . Cambridge, Mass.
ALBERT F. NOYES, City Engineer, ... Newton, Mass.
WALTER H. RICHARDS, Superintendent, . New London, Conn.
HENRY W. ROGERS, Superintendent, . . . Lawrence, Mass.
JOS. G. TENNEY, Superintendent, . . . Leominster, Mass.
CHAS. K. WALKER, Superintendent, . . . Manchester, N. H.
WM. C. WILCOX, Registrar, ... Waltham, Mass.

FINE MEMBERS.

Equitable Water Meter Co.,	Boston, Mass.
Jason Giles, Chapman Valve Manfg. Co.,	Indian Orchard, Mass.
National Meter Co.,	New York, N. Y.
Wm. B. Sherman, Secy. Corliss St. Engine Co.,	Providence, R. I.
Union Water Meter Co.,	Worcester, Mass.

VISITORS.

W. W. Hawes, Water Commissioner,	Fall River, Mass.
H. O. Sanderson, Water Commissioner,	Springfield, Mass.
Weaver Osborn, Water Commissioner,	Fall River, Mass.
A. A. Haggett, Water Commissioner,	Lowell, Mass.
A. P. Leshure, Chief Fire Dept.,	Springfield, Mass.

The report of the Executive Committee upon the last year's management of the affairs of the association was next presented as follows:

REPORT OF THE EXECUTIVE COMMITTEE.

LOWELL, MASS., June 19, 1884.

To the President and members of the New England Water Works Association:

GENTLEMEN: — The second Annual Report of the Executive Committee is herewith laid before you. Accompanying and constituting a part of this report will be found the financial statement of the Secretary, and the Report of the Treasurer.

From the statement of the Secretary it will be seen that during the past year there have been received from initiation fees, $85.00; from dues, $66.00; total, $151.00, all of which has been paid over to the Treasurer.

The Report of the Treasurer shows that the total expenses since the last report amount to $171.90, an amount $20.90 in excess of the receipts of the year. The balance on hand at the present time is $141.38.

At the present time our membership is 48 Active, 9 Fine, total, 57; an increase of 14 during the year. From present indications this number will be considerably increased during the present convention.

There have been two meetings of the Association during the past year, one at Worcester, the other at Pawtucket. As full reports of these gatherings have already been published, further comment at this time is unnecessary.

Although this society is still in its infancy, it has been the means of disseminating a large amount of practical information among its members. With an increased membership this work will be proportionally extended. No efforts should be spared to constantly offer inducements to those outside our ranks to become members. This can best be accomplished by keeping our discussion up to a very high standard.

In conclusion we extend thanks to all those who have extended courtesies, and from all members we bespeak for the future the same active interest in the affairs of the Association, as has been evinced in the past.

Respectfully submitted,

FRANK E. HALL,
HORACE G. HOLDEN,
CHARLES K. WALKER,
EDWIN DARLING,
SHERMAN E. GRANNIS,
R. C. P. COGGESHALL,
H. W. ROGERS,
THOS. C. LOVELL,
WM. R. BILLINGS,

Executive Committee
N. E. W. W. A.

Upon motion of Mr. Ellis, of Springfield, *voted* that the report be received and entered upon the records of the meeting.

The report of the Treasurer was next presented and read as follows:

SECRETARY'S REPORT.

Financial Statement of R. C. P. Coggeshall, Secretary, for the year ending June 18th, 1884.

DR.

1883.				Initiation Fee.	Dues.
June	21st,	To Cash,	Knowles Steam Pump Co., by Wilbur D. Fiske,	$10 00	
"	"	"	Equitable Water Meter Co., by C. H. Baldwin,	10 00	
"	"	"	David W. Horan,	5 00	
"	"	"	Nathaniel I. Jordan,	5 00	
"	"	"	George A. Ellis,	5 00	
"	"	"	Thomas A. Hodge,	5 00	
"	"	"	William R. Billings,	5 00	
"	"	"	Geo. F. Blake Mfg. Co., by G. F. Blake, Jr.,	10 00	
"	"	"	J. W. Lyon, to June, 1884,		$2 00
"	"	"	H. G. Holden, " "		2 00
"	"	"	E. Darling, " "		2 00
"	"	"	Phineas Sprague, "		2 00
"	"	"	C. K. Walker, " "		2 00
"	"	"	R. M. Gow, " "		2 00
"	"	"	F. E. Hall, " "		2 00
"	"	"	T. C. Lovell, " "		2 00
"	"	"	J. G. Tenney, " "		2 00
"	"	"	W. W. Hawkes, " "		2 00
"	"	"	H. N. Hyde, Jr., " "		2 00
"	"	"	W. C. Wilcox, " "		2 00
"	"	"	H. W. Rogers, " "		2 00
"	"	"	S. E. Grannis, " "		2 00
"	"	"	J. Stewart Brown, "		2 00
"	"	"	W. H. Richards, " "		2 00
Aug.	29,	"	R. C. P. Coggeshall, "		2 00
"	"	"	James H. Hathaway, "		2 00
			Carried forward,	$50 00	$36 00

1883.				Initiation Fee.	Dues.	
			Brought forward,	$50 00	$36 00	
Aug.	31,	"	A. H. Martine, to June 1884,		2 00	
"	"	"	J. C. Hancock, " "		2 00	
Sept.	5,	"	J. M. Battles, " "		2 00	
"	"	"	Addison Lane, " "		2 00	
"	"	"	P. W. Bagnell, " "		2 00	
"	7,	"	Hiram Nevons, " "		2 00	
"	19,	"	Daniel S. Brinsmade,	5 00		
"	"	"	J. Henry Brown,	5 00		
"	"	"	Nathaniel Dennett,	5 00		
"	"	"	Horace H. Knapp,	5 00		
"	"	"	Alvoid O. Miles,	5 00		
"	"	"	James W. Morse,	5 00		
"	"	"	Charles W. Morse, "		2 00	
"	"	"	Moses Joy, Jr., " "		2 00	
Oct.	17,	"	H. B. Winship, " "		2 00	
Nov.	9,	"	A. S. Glover, " "		2 00	
"	"	"	A. F. Noyes, " "		2 00	
"	10,	"	Jonas M. Clarke, "		2 00	
1884.						
Jan.	18,	"	H. L. Schleiter, " "		2 00	
"	28,	"	W. F. Hill, " "		2 00	
Feb.	15,	"	W. T. Dotten, " "		2 00	
			Total,	$85 00	$66 00	$151 00

CR.

1884.		
June 18th,	By Cash paid Edwin Darling, Treasurer,	$151 00

TREASURER'S REPORT.

EDWIN DARLING, TREASURER, JUNE 19TH, 1884.

DR.

1883.			
June 20,	To balance on hand as per last report, deposited in Providence County Savings Bank,	$127 71	
" "	Cash on hand,	29 43	
	Carried forward,		$157 14

	Brought forward,		$157 14	
July 16,	To accrued interest on deposit,		2 54	
1884.				
Jan. 24,	" " " " "		2 60	
June 18,	To cash from R. C. P. Coggeshall, Secretary,		151 00	
				$313 28
	CR.			
1883.				
June 30,	By cash paid W. E. Tanner, reporter,		$33 75	
1884.				
June 18,	" G. H. Walker, lithographs,		13 00	
"	" Mercury Publishing Co., printing,		107 61	
"	" R. C. P. Coggeshall, Secy., postage, etc.,		17 54	
"	" Balance, deposited in the Providence County Savings Bank,	$132 85		
"	" on hand,	8 53	141 38	
				$313 28

Respectfully submitted,
EDWIN DARLING.

Correct:
JAS. H. HATHAWAY, Chairman of Committee on Finance.

Mr. Glover, of Newton, for the Finance Committee, reported that the accounts of the Secretary and Treasurer had been examined and approved by said committee.

Upon motion of Mr. Grannis, of New Haven, the report was accepted and placed on file.

The next business in order was the election of officers.

Mr. Horan, of Clinton, moved that the President appoint a committee of five to bring in a list of officers for the ensuing year, to be voted upon by the convention. The President suggested as an amendment that the committee be

appointed from the floor. Mr. Horan accepted the amendment. The motion passed as amended, and the following committee was chosen: Messrs. Horan of Clinton, Dennett of Somerville, Billings of Taunton, Grannis of New Haven, Conn., and Miles of East Providence, R. I.

Mr. Miles was appointed in place of Mr. Coggeshall, the Secretary, who desired to be excused as his duties required his attention.

The committee retired for consultation and a recess was taken, during which the payment of dues to the Secretary was in order.

The nominating committee soon after returned and submitted the following list: President, Frank E. Hall, of Quincy; Vice Presidents, Charles K. Walker, Manchester, N. H.; Horace G. Holden, Lowell; A. O. Miles, East Providence, R. I.; Nathaniel I. Jordan, Auburn, Me.; W. H. Richards, New London, Conn.; Secretary, R. C. P. Coggeshall, New Bedford; Treasurer, Edwin Darling, Pawtucket, R. I.; Executive Committee — Henry W. Rogers, Lawrence, Mass., Sherman E. Grannis, New Haven, Conn., George A. Ellis, Springfield; Finance Committee — James H. Hathaway New Bedford, Thomas C. Lovell, Fitchburg, J. Henry Brown, Boston.

Mr. Miles stated that he must decline to serve as Vice President, and would recommend the name of Mr. Darling in his place.

President Hall. You have heard the report of your committee appointed to report a list of officers for the ensuing year; what is your pleasure regarding it?

A motion was made to accept the report.

Mr. Coggeshall: Mr. President and gentlemen: — For two years I have accepted and filled the office of Secretary. Now I must earnestly ask to be relieved, as I have as

much business at home as I can possibly attend to; and I do not think it any more than right that somebody else should take the position.

MR. DARLING: I move that the Secretary be instructed to cast a ballot for the officers as a whole. The motion was put, and Mr. Coggeshall reiterated his positive declination.

PRESIDENT HALL: Gentlemen, I must say a word at this time, before any further action is taken. I cannot take the position of President another year. Not that I do not appreciate your expression of good will toward me, but there are two reasons why I cannot accept, either of which, in my mind, is sufficient. In the first place, I have held the position one year, and as there is much honor connected with it, it should be divided among the Association. Then there is another reason: there are men in the Association much better fitted for the position than I am. We have a meeting of the American Water Works Association to be held in New England this year, and we wish to have the best men to represent our Association. I will endeavor to work for the interests of the Association to the best of my ability, as faithfully as though I were in office. And in relation to the Secretary, I consulted with him several times last year and know that his duties are more laborious than any one has any idea of, until an examination is made of the affairs under his charge. While it has been my wish to retain our present Secretary, after consultation with him, knowing his situation as I do, I cannot ask him to fill the office any longer.

I must positively decline the position of President myself, and hope you will make a new appointment.

Mr. Horan asked if Mr. Darling's motion was still before the house, and at the request of the President Mr. Darling repeated his motion that the Secretary be instructed to cast one ballot for the list of officers as nominated.

MR. WILCOX: I should like to make an amendment to that motion. It seems to me that when members give good and sufficient reasons for not accepting office, that these reasons ought to be considered by the Association. I would therefore amend the motion of Mr. Darling, that the committee retire again and see if they consider it advisable to change their report.

MR. BILLINGS: I am not ready to vote for the amendment, and hope it will not prevail. I would move that the committee report be amended one name at a time and that the balloting proceed singly. I hope Mr. Darling will withdraw his motion.

MR. ELLIS: Mr. President, I admit the force of your own and the Secretary's remarks, and yet I think there is no member of the Association but what feels that the experience had by both these officers who wish to decline is worth a great deal to the Association. It takes some time to learn the ropes. And I beg to differ from the President in one respect that we have any better men in the Association to hold the office than the present incumbents, and I most earnestly hope they will withdraw their declinations.

MR. COGGESHALL: As I am situated this year I have a large amount of work to perform at home, as we are making extensions. If I accept this position I must put in Sunday work for the next three months. It is only just that somebody else take the place, and do some of the work of the Association.

MR. DARLING: Mr. President, after hearing the remarks of both yourself and the Secretary, I feel that perhaps it would be better to withdraw my motion, although I hoped the management would continue along as it has been. I will therefore withdraw the motion I made, and I think that under the circumstances the committee had better retire again.

MR. WILCOX also withdrew his amendment, and Mr. Billings made his motion that the convention proceed to ballot for one officer at a time and that before each ballot is taken the name of the candidate be read.

MR. BROWN, of Boston, moved as an amendment that the report be re-submitted to the committee for action.

MR. BILLINGS objected, as it would take more time to get at the result, if the amendment were carried.

MR. CHASE suggested that the Secretary be instructed to cast one ballot for the officers not in dispute.

MR. DARLING: I will merely say that this has been the usual form to make nominations — it is the plan in the American Association. If the President cannot serve we must appoint somebody else.

MR. BROWN'S amendment prevailed, and the committee retired again. After an absence of a few moments they returned and reported that they had substituted the name of Hiram Nevons of Cambridge for President and that of Albert S. Glover, of Newton, as Secretary.

MR. DARLING: I now move that the Secretary be instructed to cast one ballot for the officers as reported.

MR. NEVONS: I want to facilitate this work as much as anyone. I shall positively decline to accept the office, and I think the committee made a woful mistake in making the change. I do not feel competent for the place, and especially after hearing the remarks of the President. I submit this as a minority report.

THE PRESIDENT: I will state for the information of Mr. Nevons that it was decided while he was out with the committee, that the members whose names were brought in this time could not decline. Gentlemen, you have heard the motion of Mr. Darling and also the remarks of Mr. Nevons. Those in favor of the motion will please manifest it by the usual voting sign.

Mr. Darling's motion was carried unanimously and Secretary Coggeshall cast the ballot as instructed, and announced the names of the officers elected.

THE PRESIDENT: I congratulate the convention upon the selection of officers made.

MR. ELLIS: I move that the chair appoint a committee of two to wait upon the newly elected officers to their positions.

Mr. Nevons again positively urged his declination.

MR. BILLINGS: As Mr. Nevons is determined not to accept the office of President, I move that the name of George A. Ellis of Springfield be substituted. Mr. Horan moved as an amendment that Mr. Nevons' declination be accepted, and that the Secretary be instructed to cast one ballot for Mr. Ellis as President. The motion was carried unanimously and the ballot was cast by the Secretary for George A. Ellis of Springfield.

THE PRESIDENT: Gentlemen, I have great pleasure in announcing that as the result of your ballot you have elected Mr George A. Ellis President for the ensuing year. This will make a vacancy in the Executive Committee, as he will be a member of the committee by virtue of his office.

SECRETARY COGGESHALL: I move that Frank E. Hall of Quincy be elected member of the Executive Committee to fill the vacancy. The motion was seconded, put by the Secretary and carried unanimously.

MR. HORAN moved that a committee of two be appointed to conduct the newly elected officers to their places.

MR. ELLIS moved as an amendment that the constitution be so changed that the officers be allowed to take their places at the close of the present convention. Mr. Horan withdrew his motion.

MR. DARLING: It is proper to have a general understanding on that point, and I think it will be understood by all that the present officers will preside during the two days of this convention, and that the incoming officers will preside next year in the same way, and take their places at the commencement of the next convention, wherever it may be. This construction can be put upon the constitution by supposing the word "meeting" to mean the entire convention.

MR. ELLIS: I am glad that this view of the case is taken and that the present arrangement will continue. I thank the gentlemen for the honor conferred upon me, and bespeak their assistance to further the good of the Water Works Association. If they will bear with me I will try to serve them to the best of my ability; but I am sorry that the best man in the association declines to serve.

MR. BILLINGS: I give notice that I shall move at the next meeting to change the word "meeting" to the word "convention" in Section 6, Article VI, of the Constitution and By-laws.

MR. DARLING: The word "convention" would be just as well, as that was the understanding when the rules were formed, although the word "meeting" was used instead.

THE PRESIDENT: I am happy to announce that Mr. Sherman of Providence has a matter that may be interesting to all, and I think we shall all be glad to hear it.

MR. WILLIAM B. SHERMAN, Secretary of the Corliss Steam Engine Company of Providence, R. I., next spoke as follows:

Mr. President and Gentlemen: I ceased to be a superintendent of water works several years ago, but still have the same hearty interest that I always have had, and it is for that reason that I wish to bring this subject before

you this morning. The Association I believe is productive of a great amount of good, but are we doing all we can do? Are we all working as hard as we can? The papers that are read are, to a certain extent, general, and I think we ought to go more into the details of the thing.

I proposed writing a paper upon this subject, but in looking over the Engineering News from week to week I casually came across an editorial which met my views exactly, and with your permission I will read that and afterwards present a scheme, somewhat in detail, which will not involve much labor, expense or trouble to carry out, and if you look at it in the same light I do, I have no doubt you will give it your hearty approval.

Mr. Sherman then read the following from the Engineering News of May 17, 1884.

THE SUPPRESSION POLICY OF AMERICAN ENGINEERS.

We recently had occasion to investigate, from a historical stand-point, one of the most important branches of civil engineering in America, and were very forcibly struck with the extreme poverty of the literature upon the subject. The only accessible data was made up of scattered newspaper accounts, generally written by unprofessional men, or the reports of engineers who gave the most meagre details, or no details at all; who seemed rather to desire the concealment of their experience than to place it at the disposal of their brethren. In our professional libraries, we found full accounts of how an English, a French or a German engineer had done similar work; but our search after the American practice was discouraging and disappointing.

This should not be; and the profession of civil engineering can not advance in this country, in proportion to the

demands upon it, until this evil is corrected. In the case in question, each individual piece of work was an important link in the history of a comparatively new process; and without the consecutive and detailed account of each, no comparison of results nor measure of progress could be made. As a result of this policy of suppression, we found that blunders had been repeated, bad methods copied, and money wasted.

Without the data of previous trials, failure and successes before him, each new engineer had been dependent solely upon his own intelligence, general skill and ingenuity; and as every man is not a genius, many of these men spent their time in groping in paths where others had stumbled before them, instead of improving upon older methods and developing new ideas to the general advance of the profession.

We have heard various reasons advanced for this scarcity of published engineering details. One is, that engineers are too busy — they have no time to write. This excuse is thread-bare, and will not stand the test of an examination; every engineer can find time, if he takes a proper interest in his profession, to detail whatever there is new and interesting in his daily practice. If he has no interest in the matter, the profession probably loses little by his reticence.

There is another class of engineers who claim that the knowledge gained by hard work and experience, is private property, their capital in trade, which is not to be spread, even before their professional brethren, without a solid return. To this latter class, we say that you are wrong. No one man is the possessor of all knowledge, and the detailed experience of the many is valuable to all; and it is more valuable to the expert than to the beginner, because the first is in a better position to use it. It is only by closely study-

ing the combined experience of a profession, under a variety of conditions, that radical advance can be hoped for, and in this case a history of failure is as useful as that of success.

To the man who fears to tell what he knows, lest others should do likewise, we would say, that no two pieces of work are exactly alike, and a complete description of one undertaking will rarely furnish sufficient data to enable an engineer, who possesses no other knowledge or qualifications, to carry forward successfully another somewhat similar work.

This scattering of information is, after all, little more than a professional duty, and it should be a pleasant duty to each member of the profession to warn his brother of the pitfalls in the way,and to prevent him from repeating the blunders of ignorance and inexperience. If from the vantage point of past experience this brother advances and developes a new idea and a better plan, the class he belongs to is the gainer, and he only paves the way for further good work on the part of his successor.

Foreign engineers evidently do not believe in the suppression policy, if we can judge from the nature and quality of their published reports. The Institution of Civil Engineers gives to its 4000 members a vast amount of useful, detailed information, and not content with English practice, gives excerpts from that of other nations. The engineers of France pursue a still more liberal policy, and their well organized and magnificently equipped national school of engineering is the receptacle for the most minute and detailed accounts of the doings of the working engineers. The student as well as the expert, has the advantage of this; these plans and estimates and full reports are accessible to all; the best are published, and the novice in the art has the experience of all who went before him to guide or check him

in his course. There is complete data to work upon, whatever may be the particular information sought.

The American policy may produce more self-reliant engineers, and be more fruitful in original ideas and plans, but it as often results in disaster to the beginner and a needless waste of public funds. The reverse of the policy would in no wise interfere with the national desire for "something new," nor with the display of Yankee originality. The results would often be only the more brilliant by being built upon a full knowledge of what has been done before.

MR. SHERMAN: Now, then, gentlemen, this is headed "the suppression policy of American engineers," but it is as applicable to you as superintendents and I am going to talk as though I were in the business. If I had written an original paper I should have left out that word "suppression" because in my intercourse with superintendents in New England I have always met the kindest courtesy, my inquiries have been answered fully, and I do not think that is the trouble with us. The trouble is that in our daily practice there are little things that we do not think to say anything about. Of course we want to show our friends a nice dam or reservoir, and all that sort of thing, and we get a good idea of the general arrangement. But we do not get any idea of the little things for which we spend a few dollars every day.

Now I am going to call up some matters, and I shall mention some names in a good-natured way. Our friend, Mr. Darling, built a new pumping station last year which gave him two stations both pumping into one reservoir by separate routes, and the result was that when both pumps were in operation he got an excess of pressure. He wanted to connect the two to reduce this pressure — what size pipes should he use? He first considered sixteen inch diameter,

then twelve inch. He had no data to fall back on but dry formulas, and finally decided to put in twelve inch pipe. The result was that the pressure was sufficiently reduced and made equal at both stations, the difference in cost of sixteen inch and twelve inch pipe was saved, and I would give more for that experience than a cart-load of formulas.

Now there is the case of Mr. Hawkes. I wrote to him when I was in the water works about a watering-cart connection. He had made use of an ordinary gas-lamp post for his stand pipe — the whole thing was put together at small cost and answered every purpose.

Mr. Rogers says he is changing a lot of wooden gate-boxes and putting in iron ones. Now we want his experience upon that matter. A man that never had any experience in making iron gate-boxes might make them three-quarters of an inch thick, and if Mr. Rogers could prove that three-eighths is thick enough, his opinion is what we want.

Every member has got something in his daily practice, I do not care how trivial it is, that would be a matter of general information to the members of this association. We can spell large words; it is the little words that trouble us. It is the details we want; we want the meat of the thing.

Now I have prepared a little sketch which I desire to show you.

[Mr. Sherman then distributed to the members duplicate copies, on sheets 10x15 inches in size, of a sketch, showing the sectional parts of a revolving stone screen, used in the City of Providence. He then resumed as follows:]

This sketch is only presented to illustrate my point and does not show any original work of my own; I merely made the sketch as the subject was a convenient one. This sketch is made by the hektograph process, with which the most of you are doubtless acquainted. It is inexpensive, and forty

or fifty copies can be easily taken. The sheets should be uniform in size, with the name plainly printed in the upper right hand corner as I have done in this one. They could easily be bound together for convenience of reference. I am not a member of the Association, and have no vote here, but I would like to get you all interested in this matter. I believe if you all take as much interest as I do, every man will be an enthusiast on the subject. Let each member make a sketch, uniform in size with this, illustrating some feature of his work, and bring it to the next meeting. Forty or fifty pages of this kind, on various subjects, would amount to more to you than any pamphlet ever published in the English language, and would contain invaluable data.

I don't know as I have anything further to say, but I could talk half a day on the subject.

THE PRESIDENT: We should be happy to have you.

MR. SHERMAN: I am a thorough enthusiast on this subject and think it could be made invaluable. For instance, take Mr. Darling's case: Let him show on a sheet of paper the same size as mine, the location of his reservoir, location of his No. 1 pumping station, and also of his No. 2. And let him add a few words of explanation, giving the pressure before the connecting pipe was laid and the decrease of pressure after it was in operation. In the case of the gate-boxes, let there be rough sketches, giving the cost per hundred, if possible. I believe that the Superintendents have to deal with the economy of the question as much as anything; and I think the *spirit* of this Association, so far as I know it, has been free to give anything asked for in reason.

MR. BILLINGS: I think I have heard nothing since I have attended these meetings that has struck me so favorably as this proposition of Mr. Sherman. I think it is in the right direction, and I will promise that at the next meeting I will

bring one or more sketches of this kind. I think I have one or two things that will be of interest. I am at present struggling with a coffer dam that has thirty feet of quicksand under it, and I will tell you how it has broken through twice on me.

MR. COGGESHALL: I will also promise to bring something of interest next year.

MR. SHERMAN: Mr. Coggeshall is expending a great deal of money and he ought to get valuable information. It is the trivial things we want.

THE PRESIDENT: I will say that Mr. Sherman has hit the very truth that many of us have been striving to bring about, and he has started what many of us desire to accomplish. He has told us how to make a beginning and I do not know how the matter could be brought up in a better form. He has suggested the thing we want to get at and told us how. Mr. Sherman is willing to answer any questions that may be asked, for the information of the members. Possibly something may be learned from such questions.

MR. SHERMAN: I will say in regard to the hektograph arrangement, that it may be that every member may not have one of these pads, as they are called. But I think there would be no trouble in getting your nearest neighbor that does possess one to strike off the requisite number of copies.

A member asked if the sketch could not be made with blue print as well.

MR. SHERMAN: Yes, the blue print would do as well but the process would be longer. If somebody will present an idea to the members in a tangible form, so they can have all the data to work from, I think we shall have matters next year we shall be proud of.

MR. ELLIS: I would like to suggest that it would be a good idea, when any work is being done by superintendents,

that they enter more into details in the description of that work in their annual report. And I would like to know if anybody has had such experience as the man I heard of, who said he had got tired of writing an annual report, as after he had got it nearly written the commissioners said there was no need of it as they knew it all before.

A member said he had had a similar experience himself.

Mr. Sherman approved the idea of detailed reports and said if the superintendents are making permanent work he did not see why they should not give the members the benefit of it.

Mr. Darling: Mr. President, you made an allusion in your address to the meeting of the American Water Works Association which is to be held in Boston on April 21, 22 and 23, next year. I want at this time to bring that matter up. As we are here representing the New England Water Works, I think the Association should extend hospitalities to the visitors in some way or another. And my idea is that a committee be appointed from our Association with power to make the necessary arrangements, to show that we recognize them. I do not propose to go to much expense, but merely to show some courtesy on our part. And I move that the chair appoint a committee of three or five to make such arrangements as will be in accordance with the views and sentiments of the Association.

The motion was seconded, and Mr. Horan moved to amend by referring the matter to the Executive Committee. The amendment was accepted and the motion as amended, passed.

Mr. Ellis: That fails to touch one point, which as a member of both associations I am interested in. I have a letter from Mr. Gardner, President of the American Association, in response to an invitation to be here today, expressing

regrets at his inability to do so. He says it would be a very pleasant thing if the New England Association could meet with us in Boston next Spring. I think every member of the American Association who is also a member of the New England Association thinks the same way. I desire to have the members express their opinion upon this matter, and I would therefore make this motion: That the New England Water Works Association agree to meet with the American Association, in Boston, next season.

The President asked if that would not properly come under the head of special meetings. Mr. Ellis replied that it probably would, but he hoped the motion would pass, that the members might be made to attend the meeting.

MR. DARLING: I think by the by-laws, that it would be in the province of the Executive Committee to call a special meeting to be held in Boston at that time. I think that would be the feeling of nearly all the members. We would be pleased to have you come and join us, as many of you as will, and you will be just as welcome as though you were permanent members of the American Association.

MR. CLARK of Northampton: I should like to make an inquiry. I notice in the reports of the different Water Boards during the past few years that a number of water pipes have been struck by lightning. My inquiry is, what kind of pipes were injured by the lightning? I presume some of the members have had experience, and can report upon it.

MR. ELLIS suggested that perhaps Mr. Clark could relate some experience of his own in regard to cast iron pipe being struck by lightning. Mr. Clark replied that some of the cast iron pipe was struck in his town about two years ago, but no harm came from it.

MR. WILCOX: Although not a superintendent, I

desire to state that our pipe, which is cement-lined, has been struck several times, and I look upon it as the testimony of Jehovah that cement-lined pipe is the worst ever used for the conveyance of water.

MR. ELLIS: Did it do any damage?

MR. WILCOX: No sir; it only tore up a number of rods.

MR. HYDE: We had a case in Newton where lightning struck a cast iron pipe and affected it, and also the man that was working on the pipe. I have heard of many cases where lightning has struck cement-lined pipe, where a great deal of injury has been done.

MR. LANE: I have had some experience in having lightning strike a schoolhouse in Melrose where a cement-lined pipe was destroyed for quite a length.

MR. NEVONS: I should like to have Mr. Rogers give a little bit of the history of his gate-boxes made out of iron.

MR. ROGERS: Mr. President; I am sorry to say that I should not recommend those gate-boxes, as a more economical one can be made that I think is quite as good. Our ordinary gate-box is cast in four pieces, which go together with dove-tailed joints and are secured by bolts. The inside dimensions are fourteen and one-half inches on top by thirty-two inches square at the bottom, and forty-six inches long. A frame and cover rests upon them weighing 160 pounds, the weight of box and cover together being 610 pounds. We use a foundation of stone under each box, so built as to secure a firm bearing without pressure on the pipe. The plates are one half inch thick at the top, and taper to one-fourth of an inch at the bottom with a thicker flange at either end.

Those boxes cost us about thirty dollars each, and our box arrangement is getting to be expensive, although I think

they would be cheaper in the end. At the time these boxes were designed it was thought desirable that they should be large enough to admit of making certain repairs to the gates without excavating, and it is possible to do so. But considering the infrequent occasion for such repairs, and the large extra expense of boxes of such size, I have come to think that a simple arrangement, through which the key may be inserted to open or close the gate may be quite as well. I think the interest on the amount saved thereby will more than pay for digging up the boxes.

Our boxes for Lowry hydrants are cast and set up the same as our ordinary boxes but are of larger dimensions, the weight of one with frame and cover being 975 pounds. It is necessary that these boxes should be large enough to admit of changing posts when required, and a lighter or less expensive box would probably not answer the purpose.

MR. DARLING: I have had but little experience of course, as my works are young, although they are gated very thoroughly with open gates at every intersection so that I do not have to shut out any territory. We use iron gate-boxes cast in the place, and eight-inch barrels made three-eighths of an inch thick with a flange at the bottom and the top and a cover that drops right in. The cover is made with a heavy rim, and this gate box rests on top of the gate. The six-inch gate cover we pass around generally, and have no difficulty in finding them, and I can strike the box at any time; I have never had a leaky gate or a broken one. And I have almost come to the conclusion that it is easier to dig one out than put in a box you can get down into. These boxes cost a little less than $4.00 each and I consider that they will last as long as the water, and we have no trouble with them.

[At this point in the proceedings a brief recess was taken as it was impossible for members to make themselves heard,

owing to the prevalence of a severe thunder shower. The intermission lasted about fifteen minutes and the convention was then again called to order by the President.]

MR. NOYES: The remarks made by Mr. Sherman were very interesting and it seems to me that further action should be taken by the Association upon them, as they were in my opinion of the utmost value. I would therefore move that the matter be referred to the Executive Committee, to issue a circular notifying the members that may be absent of his suggestions, and requesting that any questions they may have of interest, be brought forward at the next meeting, that we may get the full benefit of Mr. Sherman's plan. The motion was seconded by Mr. Coggeshall, and carried unanimously.

Upon motion of Mr. Ellis adjourned until three o'clock.

At two o'clock the members of the Association dined at the St. Charles Hotel by invitation of the Lowell Water Board; A. A. Haggett, President of the Lowell Board presided and several distinguished citizens, including Mayor J. J. Donovan and other members of the City Council were present. Mr. Haggett made a brief address of welcome to the members and Mayor Donovan in behalf of the City Government did the same. No other speeches were made, the members being well entertained in discussing the excellent bill of fare provided.

AFTERNOON SESSION.

The Convention was called to order shortly after three o'clock by the President. The names of A. B. Fitz, Attleboro, Lucian A. Taylor and George E. Batchelder, both of Worcester were presented for active membership by the Executive Committee, and the Secretary, by vote of the Commission, cast one ballot for the three names.

THE PRESIDENT: Gentlemen, if there is nothing else to come before the meeting, we will commence the discussion of topics that have been prepared.

There being no other matter presented, Superintendent H. W. Richards of New London, Conn., read the following paper upon

"SERVICE PIPE, MATERIAL, SIZE, ETC."

Probably in no other particular in the designing of systems of water supply have so many errors been made as in fixing the size and selecting the material for service pipe, and very little has been written regarding this subject. An inferior service pipe is often adopted from motives of economy or in deference to a popular wish, or it may happen that in the hurry of completion of the works the matter is overlooked, the attention of the engineers or managers being taken up for the time with more important matters, and the plan adopted in haste is continued. The importance of a properly constructed service pipe can be appreciated when we consider that a large portion of the annual expenditures in most cities, other than those for extension of mains, is for service pipes or connected with them. By way of preface it should be clearly understood that the following remarks apply to an ordinary service pipe only, i. e., a pipe laid from the main across, or partly across, the street to the building to be supplied; this pipe to be kept constantly full of water under pressure.

Among the qualities desirable in a service pipe the following are perhaps the most prominent: 1st. It should be free from anything likely to render the water passing through it unhealthful or discolored. 2d. It should be so durable that once laid the trouble and expense of repairs and renewal will be reduced to a minimum. 3d. It should admit of

being laid with reasonable speed and cheapness. 4th. It should be so constructed as to deliver the greatest quantity of water for a given size. The first mentioned quality is paramount, and the second should never be sacrificed through motives of economy. While there can be no economy in using a pipe not of the most lasting nature, this may be outweighed by the fact that with certain waters the most durable pipe may be unhealthful; but where possible the service pipe should be laid in the most permanent manner, thereby subjecting the public to as little inconvenience as possible and preserving the uniformity of the street covering and grade. This is especially desirable where the street is paved or macadamized.

Up to the present time the only materials extensively used for service pipe have been lead, either used alone or lined with tin and wrought iron with or without some coating or lining. Of the wrought iron pipes the following are mentioned in Croe's Statistical Tables as now in use: wrought iron without coating or plain, galvanized, tarred, enameled, and cement lined. There have been several other coatings and linings used, as tin lined and rubber coated, but they have proved unsatisfactory for various reasons and their merits need not be discussed in this paper. Plain wrought iron is used to a limited extent, but with ordinary waters is soon filled with rust. While the rust is not detrimental to health it unfits the water for laundry use, unless the water is filtered after passing through it. Some waters act on exposed iron with much greater rapidity than others, but there can be little doubt that with all waters a service pipe of the smaller size would clog in a few years. In New London one-half inch pipes were completely filled in two years. While one-fourth inch of rust would seriously obstruct a small pipe, it would be of less consequence in the

larger sizes, so that for large pipes a material may be used that should not be thought of for the ordinary size of service pipes. Most coated wrought iron pipes, from the writer's experience, are open to the serious objection that, while the coating may be proof against corrosion, the ends of the pipe where cut (as they must necessarily be in practice) and the interior of the fittings, are more or less exposed to the direct action of the water, and the rust accumulates in the couplings, elbows, T's and other fittings, causing an obstruction, while the interior of the pipe itself may remain clear. The brass cocks and fittings used on iron pipes seem also to have an affinity for iron rust and are often completely obstructed.

Galvanized, or zinc-coated iron, has probably been more extensively used than any other coated pipe, and is perhaps, with the exception of cement lined, the best of the coated wrought iron pipes. It is made by placing the plain iron pipe in a bath of acid to clean the iron, after which it is dipped in melted zinc. This forms a coating which is often imperfect and where perfect will corrode so as to obstruct the pipe, the time required varying with different waters. Prof. W. R. Nichols, in his valuable work on "Water Supply," says: "When the pipes are exposed to the action of water, corrosion begins at once; at first the action is on the zinc alone, provided the original iron was free from rust and the treatment with zinc thorough; but after a time the zinc which remains will cease to protect the iron and iron rust will begin to form. As regards this action it is simply a question of time." A one-half inch pipe will clog in from five to fifteen years and with exceptional waters may last longer. Its use has recently been abandoned in Middletown, Conn,, after fifteen years' trial; while it has been used in Hartford about twenty-five years, although mention is made of stoppages by rust

in the report of 1875. In New London over one-fourth inch of rust was formed in three years. As regards its effect on health, while it is unqualifiedly condemned by some chemists it is endorsed by others. It is probable that it is more dangerous than lead, but with ordinary waters may be harmless when used as a service pipe of ordinary length and always kept filled with water.

Tar-coated iron is prepared by a process which the manufacturers keep to themselves, with a coating probably of tar and asphalt. It is but little used as a service pipe and is open to the objection made to similar pipes.

Enamelled iron has recently been adopted by a few cities as a service pipe. The coating of enamel, which is patented, is applied at a high temperature. It is pronounced by good authority to contain no deleterious substance, to be durable, elastic, and to fully protect the iron from corrosion. This pipe seems to be open to the objection before mentioned, i. e., a want of protection at the joints where the pipe is cut. Although a liquid enamel is sold with which the exposed ends and the fittings may be coated, as it is impracticable to apply it with heat, as the pipe itself is coated, it is likely to prove but a temporary protection. With some better device for protecting the joint this pipe would seem likely to prove a good one.

Cement-lined pipe has been used in several cities and towns principally in New England, for the last twenty years, and may be said to be no longer an experiment. The process of lining the wrought iron pipe with cement is familiar to many of you, but for the benefit of those unacquainted with it I will briefly describe the process adopted in New London. The sizes used are three-fourth inch, one inch and one and one-fourth inches in the clear. Portland cement was at first used for the lining, but after experiment a small

proportion of Rosendale mixed with it was found to work better. The cement after being properly mixed is injected into the pipe with a press made for the purpose, after which two cones, of the diameter of the finished bore, are drawn through, pressing the cement against the sides. After lining, the pipes are carefully laid one side until the cement is set, when a liquid grout is poured through to fill any interstices there may be in the first coat. This process will make a three-fourth inch pipe of a one-inch plain iron pipe at an expense of about two cents per foot. Cement pipe is often laid with plain iron, galvanized or brass fittings, but none of these serve to protect the end of the pipe. There are two ways in which this object may be accomplished in a measure. One, as practised in Worcester, is to fill the plain iron couplings with cement as the pipe is laid and, after making up the coupling, drawing through a rubber cone previously inserted in the pipe. This process which requires that the cement be given time to set before the water is let on, may be quickened by the use of a quick-setting cement, but it is impracticable where joints are made with elbows or T's. The other process as practised in New London is to line the fittings with tin containing two brass ferrules of the same bore as the pipe, the ferrules projecting over the end and protecting the exposed iron. As regards health, cement-lined pipe is all that could be desired. In the writer's opinion it is, next to lead, the best pipe for service pipe and can be used where the nature of the water or popular prejudice would not admit of the use of lead.

Of the pipes other than wrought iron there is tin-lined lead and plain lead. Tin-lined lead is a lead pipe coated on the interior with a very thin coating of tin. While the coating undoubtedly protects the lead in the pipe proper, there is

a great liability of exposure at the joints, especially where made on to fittings, from the melting of the tin lining while wiping the joint. Where the lead is so exposed this pipe possesses no material advantage over lead pipe, as the action of water on lead in contact with another metal is said to be more rapid than on lead alone. In the writer's opinion, and in the opinion of higher authority, there is also a chemical or galvanic action between the two metals tending to destroy one or the other. The above objection and its high price would seem to counterbalance any advantage it may have over lead. This pipe has been used to some extent in New York city and in Providence. In the latter city it was abandoned for lead after a short trial.

Lead pipe has been in use since 1236, and since that time has been subject to infinite trials and tests as to its effect on water. It has been used and is in use today in all the principal cities in Europe and has been adopted and used as a service pipe in over fifty per cent. of the cities of 20,000 or more inhabitants in this country. Lead pipe, while a little more expensive as to first cost than wrought iron pipe, is more easily laid and much more durable. In a rocky or uneven trench, while lead can be bent or curved around obstructions, the wrought iron must be laid nearly straight. It thus reduces the cost of trenching. Lead can also be laid in one continuous length, thus avoiding joints with their attendant danger of obstruction. There has long been a prejudice against lead pipe, especially in the smaller cities and towns, owing to the popular idea that the water dissolved the lead and a dangerous cumulative poison was taken into the system when drinking water that had passed through it. This, no doubt, arose from the practice of taking water from wells and springs, through lead pipes sometimes several hundred feet long, and of drawing rain

water from lead-lined tanks and cisterns through lead pipes. Under these circumstances there is no doubt of the danger of using lead pipe, but under the conditions mentioned at the beginning of this paper, where the pipe is constantly full of water, rarely still 12 hours at a time, the danger is reduced to a minimum except perhaps with some waters of a peculiar chemical nature. Prof. W. R. Nichols, a very high authority, in a complete article published in the Sanitary Engineer of December, 1883, says: "As a rule, with waters suited for water supply, there is next to no danger in the use of lead service pipes." Reports favorable to its use were made by the Cochituate Water Board, after extensive experiments, in 1848; its use was advised by a Commission appointed by the British Parliament, and it has been recommended by numerous commissions and engineers since. Although lead has been in use for many years in all large cities, the cases of lead poisoning are very rare and when occurring, the cause can be traced to extreme lengths of pipe, a lead tank or fixtures other than the service pipe, where the lead is exposed alternately to air and water. But before adopting lead as a service pipe it is best to test the water under the same condition in which it will be used, when a protecting coating, of the compounds of lead, will usually be found to have formed on the interior of the pipe. Where wrought iron service pipes are in use they are generally, and should always be connected to the main with a short piece of lead pipe to allow for contraction or settlement and an examination of this piece will show the protecting coating. Prof. Nichols, in the article before referred to, says that with the Boston water the coating was brown on the outside from the presence of organic matter, and underneath this coating was a layer of carbonate of lead. This brown coating has been noticed in several other cities.

In order to decide the relative cost of the different kinds of pipe we will compare the cost of three-fourth inch service pipe, twenty-five feet long with one-half inch corporation cock and three-fourth inch curb cock, omitting labor, freight, cartage, stop-box and paving, the cost of which will vary in different places, the basis being the market prices of February, 1884. Taking the cost of a lead service pipe as above, weighing three and one half pounds to the foot, at 100 per cent., the other kind will cost as follows: Tin-lined lead $1.90, enameled iron 65 cents, cement-lined iron 58 cents, galvanized 50½ cents, tarred 49 cents and plain iron 46 cents. But as the cost of trenching and back filling is generally less for lead and about the same for the others, the relative cost of the service pipes complete, is more favorable to lead. Take, for instance, two service pipes twenty-five feet long, laid complete, one to be of three and one-half pound lead and one of galvanized iron. The cost of the lead service will be, say $12.00 and the galvanized, say $9.00. Suppose the galvanized pipe lasts fifteen years, after which time it must be relaid. The cost of relaying will be, say $5.50 (provided the brass cocks are not damaged), which, added to the first cost is $14.50. After allowing interest on the original difference in cost, the galvanized has cost more than the lead. Owing to the smoothness of the interior surface, lead and tin-lined lead pipe possess a larger discharging capacity than the iron pipes. From hurried experiments by the writer it was found that, while under fifty pounds' pressure, a three-fourths inch, cement-lined pipe, fifty feet long with three elbows, delivered but 21.7 gallons per minute, a lead pipe, under the same conditions, delivered 24.6 gallons per minute, or about thirteen per cent more. The discharge from the cement-lined pipe in this instance was retarded by tin-lined elbows, and it is probable that the

difference would ordinarily be eight to ten per cent., and where the elbows are of brass or unlined, perhaps less. It would seem from the above that lead pipe is the most economical as to cost, at least in the smaller sizes (possibly excepting cement lined), delivers the most water with a given size, and except with waters of an unusual nature is not detrimental to health. It is also more easily laid and requires fewer and less expensive tools, and no more skill to lay and connect it with the main. The ordinary wrought iron pipe is strong enough to withstand the usual range of pressure, but as lead pipe is made of many different thicknesses, its weight can be proportioned to the size and pressure.

The scope of this paper admits of only a brief discussion of the thickness required for lead pipe. By a table given in Fanning's Treatise on Water Supply, the tenacity of lead is stated to be 2386 pounds per square inch, and by a formula in the same work, which allows 100 pounds for water ram and a factor of safety of four, a three-fourth inch pipe weighing three and one-half pounds to the foot could be used under a pressure of 138 pounds, and one weighing three pounds to the foot under a pressure of 101 pounds. From experiments made for the Leroy Shot and Lead Co., the bursting pressure of the above weights and sizes was found to be 1225 pounds and 1072 pounds, and with the above allowance the safe working pressure would be 104 and 78 pounds, indicating a tenacity of about 2040 pounds per square inch. This would seem to indicate that it was safe to use a three-fourth inch pipe weighing three pounds to the square foot under a pressure of 75 pounds, which is lighter than the pipe in general use for that pressure. It is probable that the tenacity of the ordinary lead pipe metal is below 2000 pounds to the square inch. While it is best to err on the

safe side, a great deal of money may be saved by carefully proportioning the thickness to the pressure.

In order to get the greatest quantity of water from a service of a given size all the fittings should be of the full bore of the pipe and all cocks round way. The inner surfaces should be as smooth as possible, and the radius of the bends as great as the circumference will admit of. Where iron pipe is used an advantage might be gained by using elbows of a greater radius than those in common use. But the care used in proportioning the service pipe may be partially lost by bad work inside the building supplied. By using a service pipe one size larger than the tap, the discharge is largely increased, a three-fourths inch pipe of the ordinary length, with one-half-inch tap, delivering about fifty per cent. more water than a one-half–inch pipe with the same tap, but about ten per cent. less than a three-fourths inch pipe with a three-fourths inch tap. In the above example about one dollar can be saved by reducing the discharge ten per cent.

Nothing is more usual than for applicants for water to insist on a much larger service pipe than is necessary. Without so reducing the size as to inconvenience the consumer the time in which a given quantity is drawn should be prolonged as much as possible, particularly where large quantities are used. If an establishment requires 1000 gallons daily, it reduces the pressure on the mains much more to draw it in ten minutes than though the draft were prolonged through several hours, and the service pipe can often be so proportioned as to make this sudden draft impossible, although it is not always practicable to do so. The difference in pressure and the different requirements demand that the size of the service pipes be left with the superintendent or engineer to determine, but in general we may say

that eight gallons a minute is a reasonable quantity for a small dwelling with one family, and this quantity can be drawn through a one-half inch tap and three-fourths inch service pipe with thirty-five pounds pressure and over. The published tables of the discharge of service pipes should be used as a guide only as an allowance must be made for the friction on bends, fittings, &c. A table showing the discharge of service pipes as usually laid would be very useful.

The rule of using the best material, holds good with stop-cocks, gates and other attachments to a service pipe as well as with the pipe itself. There is no economy in using inferior fixtures of any kind. It is the practice in some cities to do without a curb stop, and when it is necessary to shut off the water to enforce a rule or make repairs it is necessary to dig up the street over the corporation cock. A stop inside the curb stone, covered with a cast iron box with lock cover obviates this and soon pays for itself.

The back-filling of the trench should be thoroughly done so as to avoid after-settlement. It has been the writer's practice to have the back-filling tamped from near the bottom to the surface with a tamper weighing about fifteen pounds, and this was found to be more effective in most soils than back-filling with water. Where the back filling is thoroughly tamped there should be no settlement of the paving.

In the above remarks I have endeavored to discuss the subject of service pipe from a business standpoint. Much more could be said regarding the strength and discharge of service pipes which I trust we may soon see embodied in a paper by some more competent member of this association.

THE PRESIDENT: Gentlemen; you have heard the paper which has just been read, and it is now before you for discussion or for any questions that may be asked upon the subject.

MR. WALKER: I should like to ask if any member has had any trouble with cement-lined pipe filling up with rust?

MR. RICHARDS: I never had the pipes fill up, but have had the couplings fill with rust.

MR. WALKER: I asked the question because I think it was asked before and was not heard.

PRESIDENT HALL: In answer to Mr. Walker I would say that with seventeen years' experience with cement-lined pipe, I have had no trouble with the pipe filling up. I have seen the couplings filled up by the rust forming on the ends of the pipe as mentioned by Mr. Richards; but with the couplings covered so that they did not come in contact with the water I have never seen any trouble.

MR. WALKER: Any trouble with the cement breaking off?

MR. HALL: No sir; at first we took great pains in unloading the pipe, but after some experience we gave it about the same treatment as iron pipe.

MR. LANE: Our works in Melrose have been in about fourteen years, and for the first three or four years we used cement-lined pipe. About that time enamelled pipe came around, and we have since used that entirely. Within the last two or three years we have had a good deal of trouble with the cement-lined pipe. The fittings we use in connection with this pipe are tinned. There was a very sluggish current of water through the pipe, and in cases where we have dug it up we have found the fittings filled with rust, the pipes, clear through, filled with sediment, and we have been obliged to put in new pipe. So far as our experience has gone with enamelled pipe, it has given perfect satisfaction. We have used it eight or nine years and have had no trouble with it so far. I think with the exception of lead, it is the best we have used.

MR. COGGESHALL: You all know I am a firm believer in lead pipe. New Bedford is one of the smaller cities that always stuck to lead pipe, and nothing else has been used since 1873. I have taken the trouble to have a section of pipe cut out of a service that was laid April third, 1869, and taken up April fifth, 1884.

[Mr. Coggeshall at this point exhibited the piece of pipe alluded to. It was apparently in as sound a condition as ever. Several other members also exhibited specimens taken from their own works, and a recess was taken for examination and informal discussion upon the subject.]

MR. HYDE, upon a re-assembling, asked if any of the gentlemen had ever seen any rust in enamelled pipe.

MR. LANE: I have never taken out a service of enamelled pipe, but I will not say that it is entirely free from rust. There is this about it, however: after it has been used and taken out, I think the enamel peels off from the inside; but no trouble is experienced when in use. I do not consider it a perfect pipe, but the best in use, of iron pipe. I use three-quarter inch pipe entirely for my services. Our water acts upon iron very rapidly, and I think it depends a great deal upon the quality of the water in regard to the service pipe used. I think for our water lead would be the most economical, and preferable.

MR. BILLINGS: We use cement-lined pipe in Taunton, and have been using it since 1876. We have had no occasion to dig up any services on account of obstructions, but I dug one up about two years ago to examine its condition. I chose a long pipe which had two couplings upon it. The couplings joining cut pieces were badly filled with rust; but those joining pieces which had not been cut were rusted very little, however. Since that time we have lined all our pipe by hand, after it has been cut. The pipe is taken off, and

cemented, and then put back again. We use enamelled fittings and elbows altogether. We do not take the pains in lining the pipe that Mr. Richards suggests, but I am not sure that it would not be better. We use clear Rosendale cement, and do not pour any grout into it. I think there is no doubt but that lead pipe is the best for services, but the question is what is the next best?

PRESIDENT HALL: I would like to ask Mr. Billings if the coupling of the two pieces of pipe where he found the rust, was unlined.

MR. BILLINGS: It was.

[Mr. Holden here exhibited a piece of lead service pipe that had been laid about ten years, and showed that the rust formed where the iron pipe comes into the socket. The same gentleman also showed a piece of lead pipe about a foot long that was badly corroded on the outside, in fact nearly eaten through in some places, although the inside was not in the least affected, apparently, which showed that the corrosion was due entirely to some peculiar chemical condition of the soil in which it had been buried.]

MR. SHERMAN: I would like to make a suggestion, as I suppose the report of this convention will be printed. My suggestion is that it would be a good plan for each member to send to the Secretary, and have added as an appendix to the report, a list of the sizes and interior diameter of the lead pipe they use, the weight per foot and the corresponding pressure. Let each representative send such a list to be incorporated into the annual report.

THE PRESIDENT: As there will be a meeting for general business this evening, we will continue this discussion at that time if there is no objection, and drop it at present to listen to a paper, to be read by Mr. Rogers of Lawrence.

MR. ROGERS was called for and read the following paper:

THE FILTRATION OF WATER.

Mr. President: It is with diffidence that I address you on the subject assigned me in the presence of so many gentlemen of superior experience and ability. And the more so as I shall feel obliged to express views somewhat at variance with many of the popular ideas with reference to the filtration of water.

The difficulties in obtaining political sanction for the construction of public water works, and the consequent creation of public debt, are such that engineers and committees having the matter in charge are generally obliged to estimate on the basis of strict economy, and in consequence are sometimes driven to adopt the nearest water source which may be considered sufficient in quantity, regardless of prejudicial surroundings, and, perhaps occasionally, of facts with reference to impurities, in which case ingenuity at once sets to work to frame some plausible theory, or devise some cunning means to allay fear and make their action seem wise. And out of such efforts at deception many errors have crept in and found acceptance as truth, not the least of which is the theory that by a very simple process, which a little gravel is made to perform at a trifling expense, the water from contaminated sources may be rendered fit for domestic use, a theory which has been eagerly caught on to as affording a possible remedy for some very serious obstacles in the way of introducing public water, and vast sums of money have been spent in experiments to perfect it. In New England such filtration is sought to be effected by passing the water through different grades of gravel, varying in distance from a few inches to many feet, either through natural beds or material selected and placed for the purpose,

and the results frequently seem at first to be quite encouraging; but the dynamiter's infernal machine is not more sure to work out its own ruin.

It is well understood that if a water needs filtering and the filtering device does its work, there is a deposit which, unless frequently and effectually removed, silts the material of which the filter is composed, diminishing the yield accordingly. It should also be remembered that water needs only to come in contact with deleterious substances to become contaminated. How, then, must it be with water which is allowed to course through material of any kind which is already defiled with a burden of filth extracted from an untold amount of just such water — filth both of vegetable and animal origin, undergoing the various stages of decomposition incident to it when held in a mass? Presuming that some have not been so fortunate as to have seen a filter cleansed, allow me to quote from the Providence Journal dated November 26, 1883, whose representative had that pleasure at the new pumping station in Pawtucket. I make this quotation simply in illustration of my theory with regard to the quantity and character of what may gather in and about a filter, and unless very frequently and properly removed, render it a fruitful source of pollution instead of what was intended and would be desirable, and not to disparage the Pawtucket filter, which I believe to be one of the best, as it is possible to keep it so cleansed as to prevent it from being a nuisance. It is claimed for it that it will "prevent fish spawn, small fish, eels and impurities of the pond from going into the mains," and, judging from this account, I should think it might to some extent, except in solution. The Journal, after describing the filter, which is two feet in thickness, composed of stones varying in size from the size of eggs to the size of peas, in layers of about

six inches, covering an area of only 460 square feet and capable, as the writer believes, of filtering 12,000,000 gallons per day, proceeds to describe the cleansing. The writer says:

"At 4 o'clock the pumps were shut down and the filter was cleaned out. This operation consisted simply of shutting the gate leading from the pond, which prevented the flow of more water into the filter, and opening a gate in the filter, which allowed the water already there to run off through a large pipe into the tail race and away down the stream. The water flowing from the pipe, at first apparently clean as it came from the pond, had begun to grow a little darker, as the water which came back through the filter reached the outlet, but not until the water got very low in the filter did it get dark enough to suggest anything exceedingly bad. As the water in the filter disappeared beneath the gravel, workmen jumped into the gallery with hose and rake, and while one washed the gravel thoroughly all over, with the hose, the other with the rake stirred up the gravel and raked it over. The influence upon the stream from the outlet was marked. It now took on the color of muddy coffee, and ran so until the gravel-washing operation was completed, running more than half the size of the pipe, and causing all who watched it to wonder if they had been drinking that stuff in their water, and been eating that stuff in their soup—before the filter was attached to the pumping station. There was enough of this to muddy the whole tail race and color the water clear out into the stream, but more was yet to come. When the gravel was thoroughly washed and it was supposed all the impurities of the lower side of the filter had been washed out that could be with mild means, the water was turned into the flume from the pond in full force to 'flush' the filter. Now came from that outlet

a stream the full size of the pipe, not the color of common mud, but of very dark, yea, black mud. Now another outlet was opened and there were two streams, flowing freely and fully, of this black water. This was the washing from the filter. This was what the filter had prevented from going into the mains. This was what that two feet of gravel had stopped on its course into the houses of our citizens to be drank without being noticed. And the two streams kept running until it would seem that filth enough had been poured out to contaminate the whole reservoir, and yet this was only the collection of one week — six working days of the pumps."

It is only fair to presume that this account of the cleansing of the Pawtucket filter, and statement of the amount of filth removed, awful as it is, was not greatly overdrawn. Now if a filter becomes so foul after only six days' use, how shocking must be the condition of one after six months' or six years' use? And still it has been deemed wise to construct extensive and costly works for filtering the entire supply of large cities, without any provision for cleansing or renewal, works eminently calculated to arrest filth and pollution of every description and retain it where every drop of water used for any purpose must percolate through and be contaminated by it. Here I wish to direct your attention to two very interesting analyses of water made for the authorities of one of our cities, by Professor Edward S. Wood of Harvard University. Many specimens were analyzed, having been collected from as many different places in that city, all subject to different conditions. Two of these will serve my purpose to illustrate how one of these uncleansible filters may spoil a water, which in its natural state stood, according to this test, above the average for purity. One of these specimens had passed through the filter, the other was taken

from the pond only a few feet distant. The results of the analyses are expressed in figures representing parts per 100,000 of water, as follows:

	Pond.	Filter.
Free ammonia	0.0040	0.0098
Albuminoid ammonia	0.0176	0.0074
Chlorine	0.15	0.80
Fixed residue	1.90	10.00
Volatile residue	1.00	2.20
Total residue	2.90	12.20
Hardness, English deg. . . .	1.	5.

Upon such demonstrations, comment seems almost unnecessary. A specimen of water was taken from a pond and found practically pure. Five minutes later it had leached through a festering bed of fertilizer, called a filter, and lost all relation to the water of that pond. And from such facts I am forced to draw conclusions adverse to the system as it now stands. I will not say that practical filtration may not be effected by some method free from these objections, for I hope and trust it will be; but I believe it as yet an unsolved problem, and, from such ways as at present suggest themselves, will be attended with such trouble and expense as to be impracticable. Certain it is that when resorted to, the filter must be wholly artificial and so arranged as to admit of thorough cleansing at least once each day, and of frequent renewal. But a pure source is better than the most perfect filtering works.

Authorities in science affirm that there is no certain way of purifying water once contaminated, except the natural one of distillation by the sun, and that the sand and gravel filter is powerless to remove the germs of disease, or dissolved mineral poisons. Then, I say, use the means appropriated for the construction of such works, and as much more as

may be necessary to reach such a source, no matter how distant, for in no other way is there assurance of safety.

THE PRESIDENT; Gentlemen, this subject is now before you, for an expression of your views.

MR. BILLINGS: I waited a few moments hoping some older gentleman would speak, but I will say a few words upon the subject. I think Mr. Rogers paper has brought out the fact to all our minds, that there are filters and filters; — methods which are good and methods which cannot be approved. And before I go any further may I suggest a distinction which it would be well to make although you may consider it finical. Would it not be better to distinguish between filtration proper, and mere straining? Is there not a wide difference between filtration as practiced in the best filter-beds of Europe, and the filtration through the Grant or Crocker filter which is simply a very good straining? Must not the amount of water which passes through a cubic foot of the filter bear a certain proportion to it to allow the word "filter,"to be used.

If the proportion of filtering material and area is in excess, do we not get better results? and may not results be obtained which would not be open to the criticisms in this paper? I hope some gentleman who has had experience will take up the subject.

THE PRESIDENT: This is a matter of interest to all and we should be glad to hear the ideas of the members whether in favor of, or adverse to the paper.

MR. ELLIS: I always had a very great respect for our friend, Mr. Walker, and I have a greater respect for him for introducing the gentleman who has spoken. He certainly has presented his case in a very strong manner. I also agree with Mr. Billings that there are filters and filters. I believe it is well demonstrated that in the filter beds of Europe and

Poughkeepsie the passage of water must not exceed six feet in twenty-four hours. Of course the amount of water which Mr. Darling has taken from 460 square feet must be a great deal more than six feet in twenty-four hours. Of course that would not come under the head of filtration; it is as Mr. Billings has suggested a matter of straining. And then the advocates of filtration never attempt to make out that you can change the chemical composition of water to any great extent. There may be a little change where the gravel beds are worked over and exposed to the air and get the action of the oxygen; there may be under such circumstances a slight change in the water in passing through it. But the impurities that are carried into water supplies such as you have around the Cambridge water works, I do not think that any such a filtration as Mr. Billings and myself have in mind, would be expected to eradicate from the water.

MR. DARLING: I never pretended that we had filtered water; it was not built with that expectation. We have a very clear stream, and had I known of this discussion, I would have brought a sample. We have a very pure water. It originates up in the Diamond Hill section in a ledgy territory, and it has several small springs running into it. We originally had simple screens, such as every water works has, probably, except in cases where the supply is taken from the height of the river, as Mr. Billings does in Taunton. We have screens at the gate house and screens at the pump. I found that fish-spawn would pass through the screens, and the first thing I knew my reservoir was filled with shiners. I put some black bass in to eat them up.

When I originated the new pumping station I built my filter gallery according to an idea I got from Mr. Holden. The water all comes from the earth and passes up through

the gallery. I first put in stones about as large as hen's eggs, and filled in with smaller ones on top, leaving the largest holes at the bottom, and the sediment is caught as it passes up through. The top layer is fine pea gravel. When the water comes up through there it is as clear as can be, and you can see the bottom through it very plainly. I find that practically we are taking the silt out of the water in addition to that. We clear it once a week, and we can clear it oftener if necessary, but I do not think it needs it. It can be cleaned in a very short time by the washing process on the top; I do not do that as much now as formerly, as I have the filter nearer perfection at present. Of course the fish spawn in dilution will come through, but ordinary fish spawn that can be perceived with the naked eye, I do not think could pass.

MR. WALKER: I have just cleaned my reservoir and taken out the fish spawn.

MR. DARLING: I have drawn the reservoir you gentlemen saw last fall, all dry, and found three-sixteenths of an inch of sediment which had been three years in collecting. Now that is what we call our filter; I have never pretended that we filtered the water, but I think we have a system that keeps out the sediment that would naturally pass the screens; I think we have as good an arrangement as anybody. To any city or town that has got a stream to give the flow, this plan would be found much cheaper and better than screens.

MR. WALKER: I would like to ask a question: Speaking of fish spawn, I want to ask if anybody knows why fish bother us up in Manchester from the last of March until June, and at no other time. They get into the corporation pipe at that time, and we have to go fishing from the last of March until June.

MR. RICHARDS facetiously suggested that perhaps the law is off at that time.

THE PRESIDENT: There is one matter of business, gentlemen, that has not been attended to, and that is, the place of holding our next Annual and Fall meetings. I mention it now that it may be talked up among the members before we assemble again this evening. Upon motion of Mr. Darling a vote of thanks was unanimously passed to Messrs. Richards and Rogers for the excellent papers they had read.

MR. DARLING then distributed among the members, printed copies of an address upon the meter system, delivered by him at the convention of the American Association at Cincinnati. "It is well known," he said, "that I am in favor of metered water and this address will give you the practical working of the system at the Pawtucket water works."

THE PRESIDENT said the thanks of the members are due to Mr. Darling for his thoughtfulness in furnishing the address, and hoped some mention would be made of it in the records of the convention.

MR. DARLING said it would be printed in the report of the convention of the American Association and every member of the New England Association would get a copy. He expressed the hope that both associations would grow in membership and influence, and that each may learn something of advantage from the discussions of the other. Our object should be to compare ideas, he said. What might be practical to one might not be to another, but the main object of the association is to compare results.

Upon motion of Mr. Ellis a vote of thanks was passed to Mr. Darling for the paper distributed; upon motion of Mr. Rogers adjourned until 7.30 o'clock.

About five o'clock the members took a ride around the

city in barges, under the supervision of Superintendent Holden, and visited several points of interest. The first stopping place was at the pumping station on West Sixth street in Centralville where the Morris and the Worthington engines were inspected. A visit was then made to reservoirs on Centralville heights, from which point a fine view of the city was obtained. A drive was then taken up Merrimack river, across the Aiken street bridge through Merrimack and Pawtucket streets, across Pawtucket bridge to the filter gallery which is on the Pawtucketville bank of the Merrimack, half a mile from the bridge. After a thorough inspection of this important feature the barges were again taken, and after re-crossing the bridge, the party was driven up Pawtucket street, along the bank of the river, and down Middlesex street to the St. Charles, which was reached about eight o'clock. Supper was next in order, at the conclusion of which the members again assembled in the parlor for the

EVENING SESSION.

The meeting was called to order, about half past eight, by President Hall.

THE PRESIDENT: The hour to which we adjourned has more than passed, but I think the time has been as profitably spent, perhaps, as though we had been at our meeting.

One matter for us to act upon is the selection of a place to hold our next annual meeting, and also our meeting in September, if it should be deemed advisable to you to hold one.

MR. DARLING: Mr. President, before any action is taken upon that subject I desire to bring one matter before the meeting. You are well aware that we have never paid our Secretary anything. He has acted two years without pay, and I am going to move that the expenses of the Secretary

be paid from the funds of the Association. I make that as a motion, and I hope it will stand for the future, until we get able to pay more than that.

The motion was seconded and put by the President.

MR. COGGESHALL: Mr. President, I sincerely hope that motion will not prevail. What I have done has been done without the expectation of compensation, as my interest has been strong in the progress of the Association. I know that just now our funds are at a low ebb. Next year it would be very proper to do it; but at present I prefer to have the matter remain as it is.

THE PRESIDENT: I will state as a matter of information, that during my connection with the Association I have been more or less cognizant of the duties of the Secretary and have had an opportunity to gain an idea of the magnitude of the work, that members generally have not, perhaps. I can assure you that the office of Secretary is no sinecure. There is a great amount of labor to be done, and it is owing to the will and enthusiasm that our Secretary has put into the work that we have been enabled to present as good a report as we have done. In the future the business will increase rather than diminish, although matters are becoming systematized, and the details are partially organized. The sum proposed to be allowed is not an adequate compensation for the duties of the office, but is a recognition of the labors performed by the officer.

MR. DARLING: I hope the motion will pass, and if Mr. Coggeshall desires to decline to accept it he can do so.

The motion was again stated by the President and carried unanimously.

MR. COGGESHALL: Of course I thank you all, gentlemen, for the amount you have voted me, and now I am going to ask you to accept the sum as a donation for the Association.

MR. DARLING: I move, Mr. President, that a vote of thanks be returned to Mr. Coggeshall for the very able and efficient manner in which he has performed his duties in the last two years. I must say that in all my experience, and I have had considerable, I have never seen a better set of books than his. I make the motion, and also that it be entered upon the records of this meeting.

The motion as made was put by the President and carried unanimously.

Mr. Coggeshall again returned his thanks, modestly.

MR. ELLIS: There was one matter that was left open this afternoon. After receiving Mr. Sherman's remarks during the discussion upon service pipe, it was voted that the members send in such data as they possess in regard to service pipe. In order to make that a profitable part of our proceedings, it would be rather better, it seems to me, that those answers should be presented in a uniform manner; that is, that the members should make out a list of the kinds of pipe used, and give their experience with that pipe. And in order to have these answers in such a shape that when entered upon the records they will mean something, I move that the Secretary be instructed to send a proper letter of interrogation to each member, containing all the points intended to be covered on the use of service pipe.

The motion was seconded.

MR. BILLINGS said it would be a good idea to have the Secretary consult Mr. Richards as to what those questions should be, and perhaps have him prepare the questions.

The motion was then carried unanimously.

MR. SHERMAN: In making the suggestion, I simply intended to confine it to lead pipe, thinking there are enough using lead pipe to give us some idea of the weights they are using, to see how they compare. Mr. Ellis proposes to take

in the other kinds, and there can be no objection to it. But I should propose to have the questions in a tabulated form — so many pounds to the foot at such a pressure and so many pounds at another pressure. I think it would be well as Mr. Ellis suggested, to include the kinds those members are using who do not use plain lead.

MR. ELLIS: My idea is that these points should be covered. In our own works we have used lead, plain iron, galvanized iron, rubber lined, enamelled and tarred pipe. At present we are using tarred pipe altogether. I think if, in addition to the questions relating to lead, the other questions are asked, we might receive answers from all the superintendents of water works in this Association. As to the weight of lead pipe, I think it usual to buy it heavy enough to be sure it will stand the pressure of the town, and measure by that weight. But in practice we do not attempt to do it in that way.

MR. SHERMAN: I beg leave to differ with Mr. Ellis, as in all my experience they use two, and sometimes three different weights of pipe. Up to a certain pressure they use what they call light pipes and below that, heavy pipe.

THE PRESIDENT: Does the printed letter of interrogation as suggested by Mr. Ellis, meet your approval, Mr. Sherman?

MR. SHERMAN: Yes, but in a tabular form for lead pipe, and I should prefer to have them separate.

THE PRESIDENT: If anyone else thinks of any suggestion pertaining to this matter it would be a good time to present it, in an informal way.

MR. NEVONS: Mr. President, if I recollect right, a committee was appointed last year to devise some method of uniformity in the reports of water works, and if I am not mistaken, Mr. Cotton, our Water Registrar, was one of that

committee. He has resigned and there was no report made. Now I think it is important to have the reports made out uniformly, so that they can be practical, and as we have had nothing on that point, I think we might hear of something regarding it, to our advantage.

THE PRESIDENT: Would it be proper, Mr. Nevons, to suggest that question to the Executive Committee as one of the topics for the next meeting?

MR. NEVONS: Yes, sir; but I would like to hear the expression of the members present upon the subject.

MR. BILLINGS: It occurs to me that there is an opportunity here for the Association to do some good work. If some one can suggest a way in which, after careful study and comparison of methods now in use, this Association could finally recommend a better form, — a list of heads under which each Superintendent should make his report, perhaps, a list of questions which should be answered in each report, and perhaps a list of topics which should be treated. There might be some general plan which should stand as the plan recommended by this Association and would tend to command some attention for it, at least. And if there was more care in putting the reports together, I think they would receive the attention they deserve, I do not know as it would be wise to ask one man to do the whole of that work, it might be well to have two or three do the corresponding and get the matter together.

MR. ELLIS: This same matter was assigned last year as a topic at the meeting of the American Association to Mr. Gardner of New Orleans. In his paper, which will be published in the proceedings, he took the ground that there are certain matters which could be treated alike in all departments; for instance: in cities in which they pump their water they can give all those details which enable compari-

sons of the cost of pumping in different cities by different machinery. And there are certain other facts which could be embodied in the literary part of the report. But the circumstances under which different departments are conducted varied so much that it was almost impossible to give a uniform method to be adopted by the different water works throughout the country. I think there is some truth in that, although I do not take the ground that it is absolutely correct. Some questions might be answered uniformly, but it would not be practicable I think to confine the report to a regular form.

THE PRESIDENT: In my mind that seems to be as difficult a problem as we have had before us; but as stated by Mr. Billings there is a wide field for good to be accomplished. Take the case of the man mentioned this afternoon; in many instances the city governments restrict superintendents as to the amount of the report that shall be printed, and perhaps not half of it would be printed. But in the present state of affairs the majority of water works reports can be made valuable as a means of information.

MR. DARLING: I was smiling at the experience we have had on this subject in the American Board. It has been assigned three times, and our friend Gardner has made the only report received. It would be very beneficial, but is subject to the difficulty you have referred to. While the superintendent might make out the report and explain it to the best of his ability to his Water Board, if they did not see fit to sign and adopt it, and should say "we do not want it," what does it all amount to? But I think if we could get the rule laid down and adopted by this Association, then the superintendents could have the face to say to the board of water commissioners: "This is the rule adopted by our Association and we should like to carry it out." I would

suggest that as many members as desire to, get out their ideas before the next annual meeting and bring them in; perhaps we can get some method out of the information submitted. I suggest this plan because my experience in the other association has convinced me that it is not an easy matter to get at.

MR. ELLIS: I do not like to brag, but I have a good deal of confidence in New England. It is no easy task, as has been said, therefore I move a committee of two, consisting of Mr. Billings and Mr. Coggeshall be appointed to consider the matter, and report at the next meeting.

The motion was seconded and carried unanimously.

MR. NEVONS: I should like to say what called me up, in regard to this matter.

I am very much interested in the consumption of water, and like to know how near I am drawing a line with other water works. The first thing I should consult would be what the consumption is, then the population, and next whether the whole city is supplied, or only a part of it. Now I have three cities in my mind that report the consumption so much, and the population so much. I also desire to know how many meters a man has, and after he has given the consumption and the number of takers, I want to know how much water is metered. I think those points are very important, for that is the way we are to tell what our water works are. I think as a rule superintendents' reports are too long, and do not specify enough. I think we want to know that if a city of 3000 inhabitants uses 3,000,000 gallons of water, whether it is supplied to manufacturers or for legitimate use. If that is given, and how much water is metered, I think the information would be valuable to all of us.

MR. BILLINGS: Mr. Nevons' remarks are valuable, and will give Mr. Coggeshall and myself a slight idea of the work

before us. I appreciate that it is no easy task. A few weeks ago in the Sanitary Engineer a gentleman who was making some reviews of water reports complained of two or three points omitted in them, and I have no idea that we can present anything like a perfect scheme at your next meeting; but we can report something, and then find out what is lacking. When the gentleman in the Sanitary Engineer finds fault because superintendents did not tell how much water was metered, and how much went to faucets, the Superintendent at Taunton would look out and see that they went in the next time. In another case nothing was said about how much water was used in the city, perhaps because it was not known.

We cannot be expected to any more than outline a very rough scheme at first, but we will attempt to do that.

MR. ELLIS: I should like to ask if Mr. Nevons, in inquiring about the use of water, means the uses for which water is taken.

MR. NEVONS: I would like to see it classified — so many gallons for manufacturing purposes, and so many for domestic.

MR. ELLIS: Unless it is metered, how can you?

MR. NEVONS: You have some basis for making up your head, you might omit that and give the metered water.

MR. DARLING. If Mr. Nevons will allow me I will say that our friend from Springfield does not know how much water he pumps.

MR. NEVONS: I think Mr. Darling is mistaken; I think Mr. Ellis knows how much water he uses.

MR. ELLIS: We do know how much water we use. We run Edison's gauge charts and we ascertain the amount of water used by the pressure: But we have plenty of water and the consumers are not limited in the amount they

use. For instance, we have a perfectly dry, sandy soil and perhaps they think it perfectly right to flood that soil. Now how can you compare the consumption per capita, that is if the water is allowed to run, to those towns where the soil is clayey.

MR. SHERMAN: I think I understand Mr. Nevons' point, and it is one pretty hard to get uniformity from. His point is this: take a city of fifty thousand inhabitants. With that factor he has got to have one hundred miles of pipe. But where are those one hundred miles of pipe located? through the thickly settled parts of the city, or in the suburbs? Now what he wants to get at is, to take the lines of pipe, — the whole number of houses, — the buildings located on those lines of pipe, and get the percentage of those abutters that actually take the water. Then he gets at, approximately, the amount of water used, and the number of persons who use it. We want to know what number of the population has access to the water. The city may have fifty thousand inhabitants, and there may be twenty thousand of them we cannot get at, especially in the early construction of the works. It is not right to decide by dividing the amount used by fifty thousand, because it is not a fair manner. The desired result can only be got at by finding out how many of that number are actually using the water, and this of course requires a great amount of individual labor.

MR. ELLIS: That is a fact, you have got to do a great amount of labor and put the details into your reports. Any man who has consulted European papers has found this peculiarity in them. They put so many little things in that a man who has not had the experience of the writer is able to profit by it.

MR. SHERMAN: A number of years ago the city of

New Bedford had some section maps. I bought two or three sets of them and got some spare copies and put the lines of pipe laid, on them. The maps had all the buildings built at that time, and I took a little blue paint and dropped it right on each water taker, and from that we could figure up the number that could avail themselves of it, and the number that actually took it, thus showing the percentage. And that is what Mr. Nevons wants.

MR. BILLINGS: Even that does not distinguish between the manufacturer and the domestic.

MR. SHERMAN: No sir; of course the manufacturers have meters and you must take that out of your total.

MR. BILLINGS: There is one very pleasant duty yet remaining to be done, and I should be very happy to do it. I therefore move that a vote of thanks be passed to the Chairman of the Lowell Water Board, the Superintendent, and all those gentlemen who have done so much to make our stay here so pleasant.

The motion was seconded by Mr. Ellis and carried unanimously.

MR. ELLIS: Mr. President, I am authorized to extend an invitation to the Association to hold its next annual meeting at Springfield. We will treat you as well as we can, and endeavor to make your visit as pleasant as possible.

Mr. Darling moved that the invitation be accepted, and that the next annual meeting be held at Springfield. The motion was seconded by Mr. Billings and carried.

The matter of holding a meeting in the Fall was next considered. Mr. Darling said that upon consulting with Mr. Nevons they had thought it a good idea to suggest a trip down Boston Harbor to Plymouth. Most of the Superintendents have business in Boston and they can arrange the business so as to make it convenient to go upon the excur-

sion at the same time. It was also suggested, that the Superintendents take their wives and sweethearts along with them. The question of the probable expense of the trip and the time required to make it was next asked, and Mr. Ellis thought it would be proper to refer the matter to the Executive Committee.

MR. BALDWIN said that he knew of no better place to spend a day in Boston Harbor than Downer's Landing. There is no certainty about making connections in going to Plymouth.

Mr. Nevons said he once knew a sea captain who named his vessel, an old one, the "Last Resort." Mr. Baldwin's suggestion of Downer's Landing reminded him of it, and he should be very sorry to think that the Association could go nowhere else. He believed in Plymouth if possible. After some further discussion, upon motion of Mr. Coggeshall it was voted to refer the matter of having an excursion in the Fall to the Executive Committee.

Mr. Ellis distributed some circulars advertising the Bell waterphone, which had been sent him by the inventor. He also read an autograph letter from Superintendent Shone of Milwaukee, Wisconsin, commending the invention for its efficacy in discovering leaks in water pipes.

Mr. Holden asked if any gentleman had given the Bell waterphone a thorough test.

MR. BILLINGS: I travelled around two nights with it, and did not find anything worth talking about, and at the points where the most trouble was expected to be found, there was not enough discovered to warrant keeping the expensive luxury. I found two leaks, and perhaps the waterphone intensified the sound somewhat. It affords a very convenient method of looking for leaks.

MR. COGGESHALL: I spent twenty-five nights last year

in using the waterphone, but think I should as soon have a steel rod with a bell on the end. It is a nice thing for a beginner, for in a windy night it cuts off the sound of the wind from the bell; but when a man gets so he can detect the wind I think the bell is equally as good. My method was to take a section, (have everything prepared the day before), and go to every service box in that section, and shut the sidewalk stop, where I found a leak inside the premises. I would then send the inspector in next morning, and he would generally find the water closet or some other fixture running. After getting all the services shut off in the section I would shut every gate in the section and try the gates for leaks. In the most I found some leaks. Last January there was a report that there was a considerable humming sound on a street near one of our wharves. I went down with the 'phone and found there was a sound at the service pipes for some 600 feet along the line of the street. Thinking perhaps it originated from a hydrant we dug it out but did not find the leak. I sounded every service box and then uncovered the pipe in several places. We finally found the leak, but not where we first thought it to be. In the place where we found it there was a six-inch pipe broken right across, and there was a tunnel running directly to the river, which had not shown itself above the surface.

MR. HOLDEN: Were any leaks found that could not have been found without it?

MR. COGGESHALL: I think I could have found all the leaks with a steel rod.

MR. NEVONS: Mr. Darling had one on trial and sent it up to me. I have had it, I think, two years. I took it out one night and I do not think it is worth a snap. Any leak that I cannot find with my ear, I will not hunt for. You need a knapsack to carry the machine around with. I think

any inspectors I have got will find any leak that you can find with that waterphone. I think it is a useless piece of machinery, and I do not think you need anything but your gate wrench or the tools you have got, to do your work with. I think the waterphone is entirely unnecessary.

MR. HOLDEN: The only advantage I think it would be in Lowell is, that in cutting out a line we have to shut out twelve or fifteen gates, and it is sometimes impossible to tell on a paved street where the leak is. I thought perhaps we could detect it with a waterphone.

MR. COGGESHALL: The best thing about a waterphone is that when you shut down a gate, you can tell when it is closely shut.

The discussion ended here.

MR. HOLDEN stated the programme as arranged for Friday, and expressed the hope that every member would remain as long as possible during the day.

MR. COGGESHALL moved to adjourn *sine die*.

MR. DARLING: I hope we shall not forget to congratulate the retiring President upon the success with which he has been enabled to carry us through his administration. We all remember very well his being at Worcester, and how well we were entertained by the Worcester people. From there we went to Springfield and he carried us through with honor and dignity. We then went to Pawtucket, and he stood the trials and tribulations well. We have now come to Lowell and he has carried us so far here, and I understand we are situated a good deal as the old lady was whose son went to muster, took part in the mock battle, and loaded his gun six times but did not fire it at all. When he got home his mother took the musket to show what she could do and fired the whole six charges at once with a result that can be imagined. And I move you, Mr. Secretary, that a vote of

thanks be tendered to our retiring President for the acceptable and efficient manner in which he has presided over the deliberations of our organization during the past year.

MR. BILLINGS: In rising to second that motion, I do it with pleasure. While we look forward with pleasure to receiving our new president next year, we shall always be glad to count among our past presidents, Mr. Hall of Quincy.

The motion was then stated by the Secretary and President Hall spoke as follows:

"I don't know what reason Mr. Darling has for piling on abuse as he has; but you have all heard his statements and can take them for what they are worth. I heartily thank you for your kind cooperation, particularly the Executive Committee and board of officers. I am under especial obligations to the Secretary, and I must acknowledge that a large share of my success has been due to his efforts. In short, I have met with the most hearty assistance from all with whom I have come in contact, and I hope, and have no doubt, that our next president will have the same hearty co-operation that I have had. It has been a pleasure to me to listen to the deliberations we have had so far, and I feel that the year which has been spent in this Association in laboring for its welfare has been a profitable and pleasant one to me.

The vote of thanks was then passed unanimously, and upon motion of Mr. Coggeshall the meeting adjourned *sine die*.

THE SECOND DAY,

Friday, was pleasantly employed by the members in enjoying the entertainment which had been provided for them by the Lowell Board.

At nine o'clock A. M. barges were in readiness, and the visitors were driven to the South Common, where the fire

department in full uniform under command of Chief Engineer Farrell was drawn up for review, and subsequently made a short parade across the common. The fine appearance of the men was the subject of general comment. From South Common the party was driven to the works of the United States Cartridge Company, where they were received by Superintendent C. A. R. Dimon, a member of the Lowell Water Board. Under his direction the several interesting processes employed in the manufacture of cartridges were inspected and explained.

From the cartridge works a rapid drive was made to the estate of General B. F. Butler on Andover street in Belvidere, where the barges passed around his house without stopping, the General not being at home. The next halt was made at the residence of Colonel Haggett, President of the Lowell Water Board, where a collation was waiting. The stay was necessarily brief, and after a hurried inspection of the Middlesex Mills, of which Colonel Haggett is paymaster, the party was driven hastily to the steamer landing on Pawtucket street, where the steamer Pinafore, Capt. Peirce commanding, was waiting, already loaded with invited guests, to convey the party to Tyngs' Island, a pleasure resort about half an hour's sail up the river.

The Island was reached about 12.30, and as dinner was not to be ready until two, the various means of enjoyment which the place afford were indulged in by those who felt so disposed.

At two o'clock dinner was announced and the large dining hall of the Island House was soon filled to its utmost seating capacity with hungry guests. Colonel Haggett presided and it needed no second invitation from him for the company to commence the discussion of the very excellent spread prepared by mine host Brown. After half an hour

passed in this very pleasant feature of the occasion, cigars were lighted and the intellectual part of the entertainment began.

President Haggett extended a cordial and hearty welcome to all present, and closed his remarks by the presentation to Mr. Chickering of Pawtucket of several souvenirs of the occasion. The Colonel's remarks and Mr. Chickering's response kept the table in a continual roar.

Colonel Haggett then called up in succession, Mr. Ellis of Springfield the president-elect of the Association, F. E. Hall, the retiring president, Mayor J. J. Donovan of Lowell, Superintendent Billings of Taunton, H. J. Moulton of the Lowell Daily Citizen, J. H. Harrington of the Lowell Weekly Sun, C. H. Latham, past member of the Lowell Water Board, Chief Engineer Collyer of the Pawtucket fire department, Alderman E. B. Quinn of Lowell, Superintendent Walker of Manchester, N. H., W. N. Osgood, past member of the Lowell Board, Commodore E. B. Peirce, member of the Lowell City Council and commander of the steamer Pinafore, and Superintendent Darling of Pawtucket, who was called in from the verandah to make the closing address.

The speeches were all very brief and pertinent, and might have continued longer, but the necessity of getting back to the city in order to catch the different trains, made it necessary to bring the festivities to a close at about five o'clock.

Upon arriving at the steamer landing in the city, horse cars were in waiting which conveyed the visiting members to the different railroad stations where they took their departure for their respective homes.

FALL MEETING,

CITY OF NEWTON, MASS., SEPT. 24, 1884.

The members of the association and their guests assembled at ten o'clock in the Council Chamber of the City Government, City Hall, West Newton, and after listening to a brief address of welcome by Edward W. Cate Esq. President of the Newton Water Board, took barges for a drive about the City. There were present Mayors Fuller of Malden and Cummings of Somerville, President Parker of the Worcester Common Council, Water Commissioners Kingsley of Cambridge, Hayden of Somerville, Dresser of Stockbridge, Smith of Salem, Briggs of Amesbury, Wilde of Malden, Gay of Manchester, N. H., Fairbanks of Natick, Robinson of Hudson, Frost of Waltham, Cleveland of Brockton, Watts of Lawrence, Gould of Westboro', Russell of Haverhill, Skillings of Winchester, and Horton of Pawtucket; Superintendents Mason of St. Albans, Vt., Fitts of Attleboro', Hancock of Springfield, Fitzgerald of Boston, Nevons of Cambridge, Hedge of North Adams, Brown of Boston, Hall of Quincy, Morse of Haverhill, Coggeshall of New Bedford, Taylor of Worcester, Morse of Natick, Brand of Norwich, Ct., Joy of Lexington, Holden of Lowell, Billings of Taunton, Babcock of Nashua, N. H., Hawkes of Malden, Gow of Medford, Dotten of Winchester, Lane of Melrose, Grush of Salem, Lyon of Lynn, Rogers of Lawrence, Horan of Clinton,

Walker of Manchester, N. H., Winslow of Waltham, Clark of Northampton, Lovell of Fitchburg, Dennett of Somerville, and Read of Lewiston, Me., George A. Kimball, City Engineer, Somerville, W. S. Barbour, City Engineer, Cambridge; George E. Batchelder, Water Registrar, Worcester, W. C. Wilcox, Water Registrar, Waltham; George B. Ferguson, Daniel Johnson and L. A. Welch, representing H. R. Worthington, N. Y. City, John Kelley, Crown Meter Co., N. Y. City, Chas. R. Baldwin, Equitable Meter Co., Boston, George T. Hill, Treasurer Peet Valve Co., Boston; Jason Giles, Chapman Valve Co., Boston, Wm. B. Shuman, Corliss Engine Co., Providence, R. I., W. A. Hall, of Thomas Hall & Co., Boston, John P. K. Otis of Union Meter Co., Worcester, J. F. Cummings of "Sanitary Engineer," N. Y. City, Professor Vose of the Institute of Technology, George A. Ellis, City Engineer, Springfield; Dexter Brackett, Assistant City Engineer, Boston, Henry Manley, Assistant City Engineer, Boston, the Mayor and members of the present and past City Government and other prominent citizens of Newton, making about 140 in all. The party first drove through Newtonville, Newton and Newton Highlands to the Upper Falls where they inspected the Filter Basin and Pumping Station; from there to the "Echo Bridge" which carries the Sudbury River Aqueduct over the Charles River; this they inspected under the care of Superintendent Fitzgerald of the Boston Works and then re-entered the barges and were driven to the Woodland Park Hotel in Auburndale where lunch was served and where also the Association presented to Mr. R. C. P. Coggeshall an engraving and cane as a token of their appreciation of his labors in behalf of the Association while occupying the office of Secretary. After spending about an hour at the hotel the party were taken to Engine House No. 3, where the hitching-

up process was witnessed and then to Newtonville where to show the workings of the Fire Department and hydrant service a general fire alarm was sounded, bringing all the apparatus to the spot. After leaving Newtonville the party were driven to the Waban Hill Reservoir and from there to Boston's Reservoir at Chestnut Hill. After about half an hour spent at this Reservoir under the guidance of Superintendent Fitzgerald, the barges were again taken for the Hotel Vendome, Boston, where they were joined by Hon. Albert Haggett of Lowell, L. Fred Rice, Esq., of the Boston Society of Civil Engineers. Superintendent Jones of the Boston Water Works and others.

At 6.30 o'clock dinner was announced, and after two hours pleasantly passed in its consideration, Mr. Cate called the Association to order and made a brief speech complimentary to the Association, and announced that letters of regret had been received from His Excellency Governor Robinson; His Honor Mayor Martin of Boston; John Bogart, Secretary, J. J. R. Cross, Treasurer, and W. H. Paine, Vice President of the American Society of Civil Engineers; Alphonse Fteley Resident Engineer New Croton Aqueduct, N. Y. City; L. H. Gardner, President, W. C. Stripe, Vice President and J. H. Decker, Secretary and Treasurer of the American Water Works Association; S. M. Gray, City Engineer Providence, R. I., and others.

He then introduced His Honor Mayor Kimball, who expressed the pleasure he felt in welcoming the Association to Newton. President Ellis responded for the Association and other speeches were made by Hon. R. M. Pulsifer of Newton; Mayor Cummings of Somerville; Col. Haggett of Lowell; President Kingsley of the Cambridge Water Board; President Powers of the Newton Common Council, President Parker of the Common Council of

Worcester and others, and after adopting a complimentary resolution of thanks to the City and citizens of Newton for their hospitality, the Association adjourned.

IN MEMORIAM.

J. WARREN COTTON,

Late Water Registrar, Cambridge, Mass.,

Died, July 30, 1884.

J. Warren Cotton was born in Boston, Nov. 21, 1835, and removed to Cambridge in 1842; after completing his education in the public schools there he in 1852 entered the employ of a firm in Mobile, Ala., with whom he stayed until the breaking out of the War; he then came North and enlisted in the Thirty-eighth Massachusetts Volunteer Regiment, being afterward assigned to the command of a company in the Eighty-eighth U. S. Infantry, one of the colored regiments raised at Port Hudson. At the close of the War he became interested in life insurance and held for several years a responsible position with a leading insurance company of Boston. In 1868 he was elected Clerk of the Common Council of Cambridge and in 1871 Clerk of Committees. In 1876 he was elected Water Registrar and held the office till his death. During his long connection with municipal offices he was noted for his diligence and faithfulness in the discharge of duty. In social life he was a pleasant and agreeable gentleman who made many friends by his courteous manners. For nearly two years he had been in poor health, and during the past year had rapidly failed physically but he retained his mental powers to the last. Owing to his feeble health Mr. Cotton had met but little with us, but in his death our Association loses a member who had always a deep interest in its affairs and one who, had his life and health been spared, would by his character and ability have brought to the Association much of honor and dignity.

MEMBERSHIP OF THE NEW ENGLAND WATER WORKS ASSOCIATION.

ACTIVE MEMBERS.

Richard W. Bagnell,	Superintendent,	Plymouth, Mass.
William S. Barbour,	City Engineer,	Cambridge, Mass.
Geo. E. Batchelder,	Registrar,	Worcester, Mass.
James M. Battles,		Lowell, Mass.
Wm. R. Billings,	Superintendent,	Taunton, Mass.
Thomas H. Brady,	Superintendent,	New Britain, Conn.
Junius A. Brand,	Superintendent,	Norwich, Conn.
Daniel S. Brinsmade,	Civil Engineer,	Birmingham, Conn.
J. Henry Brown,	Supt. Charlestown District,	Boston, Mass.
John C. Chase,	Superintendent,	Wilmington, N. C.
Jonas M. Clark,	Superintendent,	Northampton, Mass.
Robert C. P. Coggeshall,	Superintendent,	New Bedford, Mass.
Edwin Darling,	Superintendent,	Pawtucket, R. I.
Nathaniel Dennett,	Superintendent,	Somerville, Mass.
William T. Dotten,	Superintendent,	Winchester, Mass.
George A. Ellis,	City Eng'r & Registrar,	Springfield, Mass.
A. B. Fitts,	Registrar,	Attleboro', Mass.
Albert S. Glover,	Registrar,	Newton, Mass.
Robert M. Gow,	Superintendent,	Medford, Mass.
Sherman E. Grannis,	Superintendent,	New Haven, Mass.
Benjamin S. Grush,	Superintendent,	Salem, Mass.
Frank E. Hall,	Superintendent,	Quincy, Mass.
Joseph C. Hancock,	Superintendent,	Springfield, Mass.
James H. Hathaway,	Registrar,	New Bedford, Mass.
Ward W. Hawkes,	Superintendent,	Malden, Mass.
William F. Hill,	Superintendent,	Dedham, Mass.
Thomas A. Hodge,	Superintendent,	North Adams, Mass.
Horace G. Holden,	Superintendent,	Lowell, Mass.
David W. Horan,	Superintendent,	Clinton, Mass.
A. H. Howland,	Engineer,	Indian Orchard, Mass.
Horatio N. Hyde, Jr.,	Superintendent,	Newton, Mass.
Nathaniel I. Jordan,	Treasurer,	Auburn, Maine.

Moses Joy, Jr.,	President and Treasurer,	Milford, Mass.
Horace H. Knapp,	Clerk,	Lowell, Mass.
Addison Lane,	Superintendent,	Melrose, Mass.
Thomas C. Lovell,	Superintendent,	Fitchburg, Mass.
James W. Lyon,	Superintendent,	Lynn, Mass.
Alfred H. Martine,	Superintendent,	Knoxville, Tenn.
Marshall Mason,	Superintendent,	St. Albans, Vt.
Alvoid O. Miles,	Superintendent,	East Providence, R. I.
Charles W. Morse,	Superintendent,	Haverhill, Mass.
James W. Morse,	Superintendent,	Natick, Mass.
Gilbert Murdock,	Superintendent,	St. John, N. B.
Hiram Nevons,	Superintendent,	Cambridge, Mass.
Charles A. Northend,	Secretary,	New Britain, Conn.
Albert F. Noyes,	City Engineer,	Newton, Mass.
James Porter,	Superintendent,	Greenfield, Mass.
Walter H. Richards,	Superintendent,	New London, Conn.
Henry W. Rogers,	Superintendent,	Lawrence, Mass.
Daniel Russell,	Clerk,	Everett, Mass.
Henry L. Schleiter,	Superintendent,	Meriden, Conn.
Phineas Sprague,	Registrar,	Malden, Mass.
Lucien A. Taylor,	Commissioner,	Worcester, Mass.
Joseph G. Tenney,	Superintendent,	Leominster, Mass.
Charles K. Walker,	Superintendent,	Manchester, N. H.
Wm. C. Wilcox,	Registrar,	Waltham, Mass.
Horace B. Winship,	Registrar,	Norwich, Conn.

FINE MEMBERS.

George F. Blake Manufacturing Co.,	Boston, Mass.
Marshall T. Davidson, Hydraulic Engineer,	Brooklyn, N. Y.
Equitable Water Meter Co.,	Boston, Mass.
Wilbur D. Fiske, Agent Knowles Steam Pump Co.,	Boston, Mass.
Jason Giles, Chapman Valve Manfg. Co.,	Indian Orchard, Mass.
Hartford Meter Co.,	Hartford, Conn.
National Meter Co.,	New York, N. Y.
J. J. Newman & Co.,	Providence, R. I.
A. D. Wood & Co.,	Philadelphia, Penn.
Wm. B. Sherman, Secy. Corliss St. Engine Co.,	Providence, R. I.
Henry R. Worthington,	New York, N. Y.
Union Water Meter Co.,	Worcester, Mass.

ERRATA:

Page 18, last two lines should read: "The reports of the Secretary and Treasurer were next presented," etc.

Page 47, in tenth, eleventh and twelfth lines, $1.90, 65 cents, 58 cents, 50½ cents, 49 cents, and 46 cents, should read: 190 per cent, 65 per cent, etc.

Page 47, last line, "retarded by tin-lined elbows" should read: "retarded by imperfect tin-lined elbows."

Page 49, "circumference" should read "circumstances."

Page 85, the address of Mr. Granniss should read: "New Haven, Conn."

New England Water Works Association.

Source of Information.	1st. LEAD PIPE. Please state sizes used by you, giving weight per foot and head in pounds pressure for each size used and also whether you have had any bad results from the use of this pipe.	2d. WROUGHT IRON PIPE. Please state the kind used and your experience with the same.	3d. Please state the kind you are now using and your reasons therefor.	4th. Please state the kind of service pipe you would prefer to use and your reasons therefor.	5th quire servi the A
AUBURN, MAINE. by Nat. I. Jordan, Treasurer.	½ inch lead pipe 1½ pounds to foot has proved sufficiently strong for our pressure which is from 33 to 100 pounds to square inch.	We first used enamelled iron pipe. In three to five years it began to fill with rust and we were obliged to drop it.	We are now using Galvanized Iron Pipe, for the following reason: — It has not given us any trouble. In our experience of eight years it has rusted but very little outside or inside.	We know of no pipe better for our use than Galvanized Iron.	Ou woul it no poiso
BOSTON, MASS., (Mystic Department,) by J. Henry Brown, Superintendent.	⅝ inch 2½ pounds to foot. ¾ " 4 " " 1 " 6 " " 1¼ " 9 " " Our average pressure is 50 pounds to all sizes. The department has had only the best results from the use of lead pipe and considers it the only proper material for service pipe.	We use some 2 inch coated for large services and for small Fire Pipes.	As stated previously we use lead claiming that it is easily laid, more so than other material, joints more apt to be tight and less filling up of the service.		
CAMBRIDGE, MASS., by Hiram Nevons, Superintendent.		Galvanized. It is short lived in marsh land or where it comes in contact with sewerage.	Galvanized, because the first cost is the cheapest.	Prefer lead pipe on account of its durability and freedom from liability of internal crustation; also being flexible it easily conforms to any reasonable settlement of the earth without straining the cock at main.	
CLINTON, MASS., by David W. Horan Superintendent.	I use no lead pipe on our works excepting 16 inches at main pipe, this is ¾ inches 3½ lbs. per foot.	I use 1 inch wrought iron pipe, cement lined with ¾ inch hole in diameter. My experience of 12 years proves to me that this is the best. I have taken out some of this pipe that has been in use for 12 years and could not detect why it was not as good as when it was put in.	I use 1 inch cement lined wrought iron pipe as I consider it the best because it does not rust or corrode.	In dry trenches I would prefer to use wrought iron pipe lined with pure cement inside, and outside with cement mixed with sand; 1 shovel of cement with two of sand. In wet places I would prefer to use lead pipe; iron pipe is liable to rust on outside.	Cer week warn moist be al mosp one t harde warn set q
DEDHAM, MASS., by Wm. F. Hill, Superintendent.	We have no lead pipe services.	We have used wrought iron enamel pipe exclusively for services. We have only been running about 2 years — it has worked satisfactorily thus far		As far as I have seen I like the wrought iron enamel pipe as well as any.	
Everett, Mass., by Daniel Russell, Sec'y.	We are now using lead pipe ⅝ inch 2½ lbs. per ft., forty pounds pressure; this is the size and weight that has been used in the town since the works first started 1871; have had no trouble with it.	None.	⅝ inch lead 2½ lbs. per ft.; we think it the best.	Lead, (the best).	Car than limit lead soil.

Reports from Members in Matter of SERVICE PIPE.

Source of Information.	1st. LEAD PIPE. Please state sizes used by you, giving weight per foot and head in pounds pressure for each size used and also whether you have had any bad results from the use of this pipe.	2d. WROUGHT IRON PIPE. Please state the kind used and your experience with the same.	3d. Please state the kind you are now using and your reasons therefor.	4th. Please state the kind of servi pipe you would prefer to use and yo reasons therefor.
FALL RIVER, MASS. W. W. Robinson, Water Registrar.	Size. Weight per ft. Pressure per sq. in. ½ in. 2 lbs. 35 lbs. “ 2½ “ 61 “ “ 3 “ 87 “ “ 4 “ 117 “ ¾ “ 2½ “ 35 “ “ 3 “ 61 “ “ 3½ “ 87 “ “ 5 “ 117 “ 1 “ 3 “ 35 “ “ 4 “ 61 “ “ 5 “ 87 “ “ 7 “ 117 “ 1 “ 4½ “ 35 “ 1 “ 5½ “ 61 “ 1 “ 7 “ 87 “ 1 “ 10 “ 117 “ No bad results.	Not used.	Nothing but lead pipe used, as there is no danger of corrosion and filling up.	Lead pipe, as it lasts longer.
FITCHBURG, MASS. Thomas C. Lowell, Superintendent.		Wrought Iron cement lined. Our experience with this pipe has been entirely satisfactory; have used this pipe for services since 1872 and to the present time it has given good results.	Wrought Iron cement lined. First, its cost being less than any other service pipe when compared with its durability. Second, in freezing this pipe it seldom if ever bursts. In the winter of 1874 and '75 out of 400 services frozen we had but two pipes burst.	From our experience with cement li service pipes we can see no good rea for making a change.
GREENFIELD, MASS. James Porter, Superintendent.	Not a service of lead in town.	All kinds of wrought iron pipe are in use, but we prefer Galvanized to all others. Our works have been completed (14) fourteen years and we have never had to renew a service of any kind for any cause except freezing. Common black iron services laid in 1870 are still in use and no complaints but in several cases when changes have been made we found them more or less obstructed by rust.	Galvanized Iron exclusively and for the reason that it is cheap and gives entire satisfaction in every direction (with us).	Foregoing answers show our pr ences.
HAVERHILL, MASS. By C. W. Morse, Superintendent.	½ inch, 1½ lb., ¾ inch, 2½ lbs., 1 inch, 3 lbs; I use for our medium pressure, that is when it does not exceed 50 lbs. On our high service, we use ½ inch, 2 lbs. and ¾ inch 4 lb.	Have used a little tarred pipe but have given it up. Have had pipes fill up completely within six years from the time that they were put in.	Lead, because I consider it the best, for while it costs more on the start it is true economy, for when once put in, if properly done, it is the end of it.	Lead, reasons given above.
LAWRENCE, MASS. By H. W. Rogers, Superintendent.		Rubber coated wrought iron was adopted at time of construction in 1875 and used for 2500 services varying in size from ½ inch to 2 inches until July 1878 when there appeared abundant evidence that its adoption had been unfortunate. The sediment, usual in our Merrimack River water, depositing with rust at the ends of the pipe so obstructed them that it has been necessary to change all those of ½ inch diameter, and the same with larger sizes is a question of but a very few years.	Galvanized wrought iron, it being thought the best of the cheap material in use for the purpose.	Plain lead of the necessary weig strength to withstand pressure an believing it to be superior in every to any other material in practical u
Lynn, Mass. By James W. Lyon, formerly Superintendent of Salem and Lynn.	I have never used lead pipe for services.	I have used galvanized wrought iron pipe and with very good results. Have also used wrought iron lined with cement which I prefer to any other except lead; have had no trouble with it except where laid in salt marsh where the iron rusts away.	I last used cement lined wrought iron pipe because it was cheaper than lead and was free from the suspicion of poisoning the water.	I consider that lead pipe of go is the best and should use it at a left to my own judgement, for t that it is the most durable, safes est laid, and that smaller sizes to convey the same quantity of

e. Please state perience with	3d. Please state the kind you are now using and your reasons therefor.	4th. Please state the kind of service pipe you would prefer to use and your reasons therefor.	5th. Please give any information acquired by your experience in the use of service pipe, which would be of interest to the Association.	Source of Information.	1st. LEAD PIPE. Please state sizes used by you, giving weight per foot and head in pounds pressure for each size used and also whether you have had any bad results from the use of this pipe.	2d. WROUGHT the kind used an the same.
iron pipe. In n to fill with drop it.	We are now using Galvanized Iron Pipe, for the following reason: — It has not given us any trouble. In our experience of eight years it has rusted but very little outside or inside.	We know of no pipe better for our use than Galvanized Iron.	Our experience has been that lead pipe would be a very desirable pipe to use were it not for the belief so prevalent that it poisons the water.	FALL RIVER, MASS. W. W. Robinson, Water Registrar.	Size. Weight per ft. Pressure per sq. in. ½ in. 2 lbs. 35 lbs. ¾ " 2½ " 61 " 1 " 3 " 87 " 1¼ " 4 " 117 " 1½ " 2½ " 35 " " 3 " 61 " " 3½ " 87 " " 5 " 117 " 2 " 3 " 35 " " 4 " 61 " " 5 " 87 " " 7 " 117 " 1 " 4½ " 35 " 1 " 5½ " 61 " 1 " 7 " 87 " 1 " 10 " 117 " No bad results.	Not used.
ated for large Pipes.	As stated previously we use lead claiming that it is easily laid, more so than other material, joints more apt to be tight and less filling up of the service.			FITCHBURG, MASS. Thomas C. Lowell, Superintendent.		Wrought Iron e Our experience entirely satisfacto for services since time it has given
land or where verage.	Galvanized, because the first cost is the cheapest.	Prefer lead pipe on account of its durability and freedom from liability of internal crustation; also being flexible it easily conforms to any reasonable settlement of the earth without straining the cock at main.		GREENFIELD, MASS. James Porter, Superintendent.	Not a service of lead in town.	All kinds of wro but we prefer G Our works have b teen years and we a service of any k freezing. Commo in 1870 are still i but in several ca been made we fou structed by rust.
pipe, cement diameter. My es to me that n out some of e for 12 years t was not as	I use 1 inch cement lined wrought iron pipe as I consider it the best because it does not rust or corrode.	In dry trenches I would prefer to use wrought iron pipe lined with pure cement inside, and outside with cement mixed with sand; 1 shovel of cement with two of sand. In wet places I would prefer to use lead pipe; iron pipe is liable to rust on outside.	Cement lined pipe may be used in a week after it is lined if the cement used is warm and active and the pipe kept in a moist, warm room; the temperature should be about 70 degrees; the moister the atmosphere the better of course; in from one to two months it will become much harder but with care in keeping moist and warm and using good cement, which will set quickly, it can be used in one week.	HAVERHILL, MASS. By C. W. Morse, Superintendent.	½ inch, 1½ lb., ¾ inch, 2½ lbs., 1 inch, 3 lbs; I use for our medium pressure, that is when it does not exceed 50 lbs. On our high service, we use ½ inch, 2 lbs. and ¾ inch 4 lb.	Have used a litt given it up. Hav pletely within six they were put in.
n enamel pipe Ve have only ears — it has ar		As far as I have seen I like the wrought iron enamel pipe as well as any.		LAWRENCE, MASS. By H. W. Rogers, Superintendent.		Rubber coated w at time of constru for 2500 services inch to 2 inches there appeared ab adoption had been iment, usual in water, depositing the pipe so obstru been necessary to inch diameter, and sizes is a question
	¾ inch lead 2½ lbs. per ft.; we think it the best.	Lead, (the best).	Cannot give any information further than we have, as our experience is very limited; we have not tried anything but lead which works very satisfactorily in our soil.	Lynn, Mass. By James W. Lyon, formerly Superintendent of Salem and Lynn.	I have never used lead pipe for services.	I have used ga pipe and with ve also used wrought which I prefer to have had no troubl laid in salt marsh away.

Members in Matter of SERVICE PIPE.

1. WROUGHT IRON PIPE. Please state kind used and your experience with same.	3d. Please state the kind you are now using and your reasons therefor.	4th. Please state the kind of service pipe you would prefer to use and your reasons therefor.	5th. Please give any information acquired by your experience in the use of service pipe, which would be of interest to the Association.
Not used.	Nothing but lead pipe used, as there is no danger of corrosion and filling up.	Lead pipe, as it lasts longer.	We prefer lead pipe for services to all other kinds. We do not consider its use accompanied by any danger to health. All kinds of iron sooner or later fill up with rust, on account of the softness of our water.
Wrought Iron cement lined. Our experience with this pipe has been entirely satisfactory; have used this pipe in services since 1872 and to the present time it has given good results.	Wrought Iron cement lined. First, its cost being less than any other service pipe when compared with its durability. Second, in freezing this pipe it seldom if ever bursts. In the winter of 1874 and '75 out of 400 services frozen we had but two pipes burst.	From our experience with cement lined service pipes we can see no good reason for making a change.	In lining the service pipe it has been my custom to thoroughly wet the inside of the pipe just before lining and to line with pure cement, leaving the coupling on one end of the pipe with a short nipple made into the coupling which we remove as soon as the pipe is lined; this obviates the necessity of lining the coupling when laying the services.
All kinds of wrought iron pipe are in use, but we prefer Galvanized to all others. Our works have been completed (14) fourteen years and we have never had to renew service of any kind for any cause except freezing. Common black iron services laid in 1870 are still in use and no complaints have in several cases when changes have been made we found them more or less obstructed by rust.	Galvanized Iron exclusively and for the reason that it is cheap and gives entire satisfaction in every direction (with us).	Foregoing answers show our preferences.	While galvanized or even common iron pipe does us good service I know it is the reverse in many other places and I therefore conclude that the difficulty is not in the material of which pipe is composed so much as it is in the chemical nature of the water. Our water seems to affect copper more than either kind of iron pipe, a copper strainer at head having been nearly destroyed in the 14 years by the action of the water.
Have used a little tarred pipe but have given it up. Have had pipes fill up completely within six years from the time that they were put in.	Lead, because I consider it the best, for while it costs more on the start it is true economy, for when once put in, if properly done, it is the end of it.	Lead, reasons given above.	
Rubber coated wrought iron was adopted at time of construction in 1875 and used on 2500 services varying in size from ¾ inch to 2 inches until July 1878 when there appeared abundant evidence that its action had been unfortunate. The sediment, usual in our Merrimack River water, depositing with rust at the ends of the pipe so obstructed them that it has been necessary to change all those of ¾ inch diameter, and the same with larger sizes is a question of but a very few years.	Galvanized wrought iron, it being thought the best of the cheap material in use for the purpose.	Plain lead of the necessary weight and strength to withstand pressure and time, believing it to be superior in every respect to any other material in practical use.	
I have used galvanized wrought iron pipe and with very good results. Have also used wrought iron lined with cement which I prefer to any other except lead; have had no trouble with it except where laid in salt marsh where the iron rusts badly.	I last used cement lined wrought iron pipe because it was cheaper than lead and was free from the suspicion of poisoning the water.	I consider that lead pipe of good quality is the best and should use it at all times if left to my own judgement, for the reasons that it is the most durable, safest and easiest laid, and that smaller sizes can be used to convey the same quantity of water.	From my experience I should consider that, next to lead pipe, a galvanized pipe lined with pure cement with the couplings properly coated would be the best service pipe for all situations.

Source of Information.	1st. LEAD PIPE. Please state sizes used by you, giving weight per foot and head in pounds pressure for each size used and also whether you have had any bad results from the use of this pipe.	2d. WROUGHT IRON PIPE. Please state the kind used and your experience with the same.	3d. Please state the kind you are now using and your reasons therefor.	4th. Please state the kind of service pipe you would prefer to use and your reasons therefor.
LEOMINSTER, MASS., J. G. Tenney, Sup't.	We have never used lead pipe for service.	We use wrought iron pipe lined with cement, which has always given satisfaction. I never have been troubled with it in any form since I have had the care of our works. Our pipes were laid in 1873 and I have had charge of them since 1879.		
LOWELL, MASS. H.G. Holden, Sup't.	Our greatest pressure is 70 pounds and the weight per foot of lead used here is as follows: — ¾ inch lead pipe weighing 3 lbs. per ft. 1 " " " " 4 " " " 1½ " " " " 6 " " " We have had no bad results from use of lead pipe.	We have had about 300 cement lined 1 inch wrought iron service pipes which have been in use 12 years. The rust in them gathers mostly at the joints and wherever the brass cocks are connected. Many of them have already been replaced by lead or tarred iron. We have also about 4000 rubber coated wrought iron which have been laid from 6 to 12 years. Many of them are almost closed with rust while some have corroded so badly as to be useless and have been replaced by lead or tarred iron. For the past 6 years we have used mostly wrought iron tarred and time will tell whether it is any better than the other kinds.	At present we use mostly wrought iron tarred and not less than one inch diameter. The reason for using it is that it is optional with our water takers to have either wrought iron or lead and many of them object to lead simply on account of the extra cost.	Lead is preferable as it will not corrode and it will last forever.
MALDEN, MASS. W. W. Hawkes, Sup't.	We use ⅝ in. 2¾ lbs. per foot for ordinary house service under a head of fifty pounds per sq. inch. 1 inch 4 and 5 lbs. per ft. according to elevation and pressure, ¾ inch 3 lbs. per ft.	We use wrought iron galvanized for our large service 2 in. and 3 in. Never have had any trouble with these sizes. Have taken out and replaced with lead about all of our house services, ¾ inch on account of oxidation.	Lead altogether on account of its durability and being less liable to give trouble.	Lead. Less liable to fill up and less liable to leak as there are less joints and no corrosion.
MANCHESTER, N. H. Chas. K. Walker.	When I took charge of the water works 9 years ago they were using ¾ inch rubber coated pipe. We have had no trouble as yet. For two years we have used the enameled but do not put in less than an inch. We found that both the above kinds of ½ inch in the houses have got filled up with rust. The takers have put ¾ in. instead.	The lead connection is three pounds per ft.; size ¾, ½ inch tap. The pressure here is 60 pounds and we only use one kind of lead pipe.	Enamelled. I cannot give any reason. The plumbers use it here to pipe the houses and claim it the best excepting lead.	Lead, for that ends it.
MEDFORD, MASS. R. M. Gow, Sup't.	We use a small piece of lead pipe on our connections at the corp-cock for a ¾ tap 2½ lbs. per ft. For a 1 in. tap, 3½ lbs. per ft. Our pressure is 55 lbs.	We have about 500 ¾ in. galvanized iron services that were put in by the Contractor of the works when they were built about 14 years ago, and I have considerable trouble in keeping them free. Some of them I have had to renew with other pipe and others I have had dug up and cleaned the rust out of them which was principally at the couplings and the ends of the joints.	I am using cement lined at the suggestion of the Water Board; they are of the opinion that the water is much better in passing through it than lead.	I would rather use lead pipe for the reason that it is much easier to run in the trench; it also saves time necessitated in removing boulders in laying other pipe and it is much more easily repaired than any other pipe I know of.

Reports from Members in Matter of SERVICE PIPE.

nd of service use and your	5th. Please give any information acquired by your experience in the use of service pipe, which would be of interest to the Association.	Source of Information.	1st. LEAD PIPE. Please state sizes used by you, giving weight per foot and head in pounds pressure for each size used and also whether you have had any bad results from the use of this pipe.	2d. WROUGHT IRON PIPE. Please state the kind used and your experience with the same.	3d. Please state the kind you are now using and your reasons therefor.	4th. Please state the kind pipe you would prefer to use reasons therefor.
		MELROSE, MASS. Addison Lane, Superintendent.	Have never used lead pipe for services except in a few instances and then the weight per foot was 2½ lbs. Our pressure in the centre of the town is 35 lbs. to the square inch.	We use the enameled iron pipe ¾ inch. We have been using this pipe now about ten years and thus far have had no trouble from rust. I consider the enameled iron pipe the best iron pipe in use.	We continue to use the enameled iron pipe. For 2 or 3 years we used the 1 inch plain iron pipe lined with cement, but as that size was large and heavy to work and requiring also great care in lining we discontinued its use and adopted the use of the enameled pipe.	I may say that I prefer to use eled pipe or I should not contin In putting in our services we u the service all the way to the charge the expense from the s Most people prefer the iron p lead.
ll not corrode		MERIDEN, CONN. H. L. Schleiter, Sup't.	Do not and never have used it.		We use galvanized iron pipe for services, and have never used any other kind. We find it does not corrode, having taken up some that had been in use for more than twelve years and found hardly any rust in it. We have no reason to think that it is injurious to health.	Galvanized iron pipe, and for given above.
up and less ss joints and	My experience has been that lead though more expensive in the first outlay is the most economical in the end, provided the water is not contaminated in coming in contact.	NATICK, MASS. James W. Morse, Sup't.	We use no lead pipe except to connect to main which is ⅝ in., 2½ lbs. to foot. Our pressure is from 60 to 90 lbs. to sq. inch.	We used wrought iron cement lined pipe for service for three years. My experience is that there are many places where there is no lining (caused by short crooks) and here is where the trouble commences with rust which will close up the pipe in a short time.	We are now using galvanized iron pipe and it is giving very good results.	Cement lined is the most su thing; if it could be lined perfe opinion, would give the best res
		NEW BEDFORD, MASS. R. C. P. Coggeshall, Sup't.	For all service pipes having a pressure equal to one hundred feet head (43 pounds) or less we use the following weights per lineal foot. ¾ inch bore 2 lbs. per lineal foot. 1 " " 2½ " " " " 1¼ " " 3 " " " " 1 " " 6 " " " " For all service pipes having a pressure equal to more than one hundred feet head (43 pounds) we use the following weights: ¾ inch bore, 3 lbs. per lineal foot. 1 " " 3½ " " " " 1¼ " " 4½ " " " " 1 " " 6 " " " " The heaviest pressure we have is 65 pounds. For ordinary service supply we allow as follows: Pressure 60 to 65 lbs. ¾ in. bore 3 lbs. per ft. " 43 to 60 " 1 " " 3½ " " " " 23 to 43 " 1¼ " " 2½ " " " " 0 to 23 " 1½ " " 3 " " " or 1 " " 4 " " " For special cases we allow a change in size. We put in a tap and curb stop of the same size bore as the pipe. Never knew of a bad result from the use of a lead service pipe from the mains of the water works of this city.	Never had any experience of any account with wrought iron service pipes. In the earlier years of the work we laid some cement lined wrought iron services; occasionally one of them troubles us. As fast as this occurs we dig it up and replace with lead.	Use lead pipe exclusively. You will remember that I exhibited at the Lowell meeting a specimen of lead pipe which had been in constant use on these works for a period of over 13 years and which was in just as good a condition as when laid. I prefer lead pipe to any other kind. Much more durable than any other. Owing to its flexibility it can be much more easily laid. As it comes in continuous lengths, joints which are always an objectionable feature are avoided. Owing to the smoothness of its interior will deliver more water through the same sized pipe than other kinds. The cost of maintenance is little or nothing as it never fills up with rust or otherwise. It therefore is really the most truly economical pipe, its long life and freedom from care much more than counter balances its first extra cost over other kinds.	
pe for the run in the essitated in other pipe aired than	If it would be of any interest to the Association I would advise those using galvanized or cement-lined iron pipe to use a small lead ferrule or washer between the couplings, and also one at each end of the stop, which prevents the coupling and the ends of the pipe from rusting and filling up.	NEW LONDON, CONN. W. H. Richards, Sup't.	We use but 2 ft. of lead on each service pipe of the following weights per foot: ½ inch 2 lbs., ¾ inch 3½ lbs., 1 inch 4½ lbs., 1½ inch 7 lbs. We have had no bad results with the above weights under pressures from 29 lbs. to 73 lbs. to the square inch.	Cement lined with brass fittings filled with rust in 4 or 5 years. Rubber coated filled with rust in 4 or 5 years. Cement lined with tin lined fittings in use 7 years with good results.	Cement lined used because I consider it (next to lead) the best, and the consumers have a prejudice against lead.	Lead, most permanent, will most water with a given size, easily laid.

. WROUGHT IRON PIPE. Please state kind used and your experience with same.	3d. Please state the kind you are now using and your reasons therefor.	4th. Please state the kind of service pipe you would prefer to use and your reasons therefor.	5th. Please give any information acquired by your experience in the use of service pipe, which would be of interest to the Association.	Source of Information.	1st. LEAD PIPE. Please state sizes used by you, giving weight per foot and head in pounds pressure for each size used and also whether you have had any bad results from the use of this pipe.
e use wrought iron pipe lined with ent, which has always given satisfac- I never have been troubled with it ny form since I have had the care of works. Our pipes were laid in 1873 I have had charge of them since 1879.				MELROSE, MASS. Addison Lane, Superintendent.	Have never used lead pipe for services except in a few instances and then the weight per foot was 2½ lbs. Our pressure in the centre of the town is 35 lbs. to the square inch.
have had about 300 cement lined 1 wrought iron service pipes which been in use 12 years. The rust in gathers mostly at the joints and ever the brass cocks are connected. of them have already been replaced nd or tarred iron. We have also 4000 rubber coated wrought iron have been laid from 6 to 12 years. of them are almost closed with rust some have corroded so badly as to be s and have been replaced by lead or iron. For the past 6 years we have nostly wrought iron tarred and time ll whether it is any better than the kinds.	At present we use mostly wrought iron tarred and not less than one inch diameter. The reason for using it is that it is optional with our water takers to have either wrought iron or lead and many of them object to lead simply on account of the extra cost.	Lead is preferable as it will not corrode and it will last forever.		MERIDEN, CONN. H. L. Schleiter, Sup't.	Do not and never have used it.
se wrought iron galvanized for our ervice 2 in. and 3 in. Never have y trouble with these sizes. Have ut and replaced with lead about all house services, ¾ inch on account of on.	Lead altogether on account of its durability and being less liable to give trouble.	Lead. Less liable to fill up and less liable to leak as there are less joints and no corrosion.	My experience has been that lead though more expensive in the first outlay is the most economical in the end, provided the water is not contaminated in coming in contact.	NATICK, MASS. James W. Morse, Sup't.	We use no lead pipe except to connect to main which is ⅝ in., 2½ lbs. to foot. Our pressure is from 60 to 90 lbs. to sq. inch.
ead connection is three pounds per ¾, ½ inch tap. The pressure here is nds and we only use one kind pipe.	Enamelled. I cannot give any reason. The plumbers use it here to pipe the houses and claim it the best excepting lead.	Lead, for that ends it.		NEW BEDFORD, MASS. R. C. P. Coggeshall, Sup't.	For all service pipes having a pressure equal to one hundred feet head (43 pounds) or less we use the following weights per lineal foot. ¼ inch bore 2 lbs. per lineal foot. ⅜ " " 2½ " " " " ½ " " 3 " " " " 1 " " 6 " " " " For all service pipes having a pressure equal to more than one hundred feet head (43 pounds) we use the following weights: ¼ inch bore, 3 lbs. per lineal foot. ⅜ " " 3½ " " " " ½ " " 4½ " " " " 1 " " 6 " " " " The heaviest pressure we have is 65 pounds. For ordinary service supply we allow as follows: Pressure 60 to 65 lbs. ¼ in. bore 3 lbs. per ft " 43 to 60 " ⅜ " " 3½ " " " " 23 to 43 " ½ " " 2½ " " " " 0 to 23 " ¾ " " 3 " " " or 1 " " 4 " " " For special cases we allow a change in size. We put in a tap and curb stop of the same size bore as the pipe. Never knew of a bad result from the use of a lead service pipe from the mains of the water works of this city.
ve about 500 ¾ in. galvanized iron hat were put in by the Contractor rks when they were built about 14 , and I have considerable trouble g them free. Some of them I have enew with other pipe and others nd dug up and cleaned the rust em which was principally at the s and the ends of the joints.	I am using cement lined at the suggestion of the Water Board; they are of the opinion that the water is much better in passing through it than lead.	I would rather use lead pipe for the reason that it is much easier to run in the trench; it also saves time necessitated in removing boulders in laying other pipe and it is much more easily repaired than any other pipe I know of.	If it would be of any interest to the Association I would advise those using galvanized or cement-lined iron pipe to use a small lead ferrule or washer between the couplings, and also one at each end of the stop, which prevents the coupling and the ends of the pipe from rusting and filling up.	NEW LONDON, CONN. W. H. Richards, Sup't.	We use but 2 ft. of lead on each service pipe of the following weights per foot: ¾ inch 2 lbs., ¾ inch 3½ lbs., 1 inch 4½ lbs., 1½ inch 7 lbs. We have had no bad results with the above weights under pressures from 29 lbs. to 73 lbs. to the square inch.

orts from Members in Matter of SERVICE PIPE.

state sizes used oot and head in size used and any bad results	2d. WROUGHT IRON PIPE. Please state the kind used and your experience with the same.	3d. Please state the kind you are now using and your reasons therefor.	4th. Please state the kind of service pipe you would prefer to use and your reasons therefor.	5th. Please give any information acquired by your experience in the use of service pipe, which would be of interest to the Association.
pe for services and then the Our pressure s 35 lbs. to the	We use the enameled iron pipe ¾ inch. We have been using this pipe now about ten years and thus far have had no trouble from rust. I consider the enameled iron pipe the best iron pipe in use.	We continue to use the enameled iron pipe. For 2 or 3 years we used the 1 inch plain iron pipe lined with cement, but as that size was large and heavy to work and requiring also great care in lining we discontinued its use and adopted the use of the enameled pipe.	I may say that I prefer to use the enameled pipe or I should not continue to do so. In putting in our services we usually lay the service all the way to the cellar and charge the expense from the street line. Most people prefer the iron pipe to the lead.	We are having a deal of trouble with the cement lined pipe that was first laid, many of the couplings being so filled with rust that the whole service has had to be re-laid or new couplings substituted, as there is a tendency in all iron pipes to rust, especially where it is cut. I think lead pipe is the surest and most economical to use in the long run.
ed it.		We use galvanized iron pipe for services, and have never used any other kind. We find it does not corrode, having taken up some that had been in use for more than twelve years and found hardly any rust in it. We have no reason to think that it is injurious to health.	Galvanized iron pipe, and for the reasons given above.	
ept to connect . to foot. Our to sq. inch.	We used wrought iron cement lined pipe for service for three years. My experience is that there are many places where there is no lining (caused by short crooks) and here is where the trouble commences with rust which will close up the pipe in a short time.	We are now using galvanized iron pipe and it is giving very good results.	Cement lined is the most sure of anything; if it could be lined perfectly, in my opinion, would give the best results.	
ng a pressure ead (43 pounds) g weights per neal foot. " " " " ng a pressure lred feet head ving weights : neal foot. " " " " " " e have is 65 ce supply we e 3 lbs. per ft. 3½ " " " 2½ " " " 3 " " " 4 " " " a change in b stop of the from the use the mains of	Never had any experience of any account with wrought iron service pipes. In the earlier years of the work we laid some cement lined wrought iron services; occasionally one of them troubles us. As fast as this occurs we dig it up and replace with lead.	Use lead pipe exclusively. You will remember that I exhibited at the Lowell meeting a specimen of lead pipe which had been in constant use on these works for a period of over 13 years and which was in just as good a condition as when laid. I prefer lead pipe to any other kind. Much more durable than any other. Owing to its flexibility it can be much more easily laid. As it comes in continuous lengths, joints which are always an objectionable feature are avoided. Owing to the smoothness of its interior will deliver more water through the same sized pipe than other kinds. The cost of maintenance is little or nothing as it never fills up with rust or otherwise. It therefore is really the most truly economical pipe, its long life and freedom from care much more than counter balances its first extra cost over other kinds.		Years ago it was the practice on these works to fasten the bottom of the curb stop box to the lead pipe by filling in with hydraulic cement. I find wherever this was done or in any other place where lead pipe is enclosed within cement that the lead corrodes quite badly from the outside of the pipe. Therefore for a long time we have not allowed any lead pipe to be placed in contact with cement. We laid a few tin lined lead pipes some years ago; after a few years found they corroded badly, consequently we abandoned it.
each service per foot : inch 4½ lbs., lts with the s from 29 lbs.	[5]Cement lined with brass fittings filled with rust in 4 or 5 years. Rubber coated filled with rust in 4 or 5 years. Cement lined with tin lined fittings in use 7 years with good results.	Cement lined used because I consider it (next to lead) the best, and the consumers have a prejudice against lead.	Lead, most permanent, will deliver the most water with a given size, and is most easily laid.	Have known ½ in. 1 lb. 10 oz. pipe to give out under 50 lbs. pressure after several years' use, and ½ in. tin lined lead weighing 1 lb. 12 oz. to stand for 12 years 70 lbs. pressure.

Source of Information.	1st. LEAD PIPE. Please state sizes used by you, giving weight per foot and head in pounds pressure for each size used and also whether you have had any bad results from the use of this pipe.	2d. WROUGHT IRON PIPE. Please state the kind used and your experience with the same.	3d. Please state the kind you are now using and your reasons therefor.	4th. Please state the kind of service pipe you would prefer to use and your reasons therefor.
NORTH ADAMS, MASS. Thomas A. Hodge, Sup't.	Not any; lead pipe is poisonous and rats will eat a hole through it when they can get at it.	We have used wrought iron pipes, plain tarred and galvanized pipe.	Are using tarred pipe, size 1 inch for service.	
NORTHAMPTON, MASS. J. M. Clark, Sup't.	We use lead pipe only for connections between the corporation cock and iron pipe. Most of these connections are ¾ inch caliber, and 12 or 15 inches long, weighing 5 lbs. to the foot. In the early history of our works, lighter pipe was used, put in by contract, from which we have had considerable trouble from bursting, but none from the heavier pipe we now use. Our pressure in the majority of taps is from 75 to 100 lbs. to the sq. inch.	Our Commissioners began with the cement lined, wrought iron pipe. One inch pipe, lined down to ¾ inch. In some instances the lining became disconnected, and obstructed the water flow, and also rusted at the joints. We tried rubber-coated, but the coating came off. We tried tar-coated, but it gave a bad taste to the water for some time. For the past three years we have used the enamelled, with entire satisfaction.	The enamelled pipe. 1. It gives no taste to the water. 2. It resists rust better than any we have tried. 3. It gives entire satisfaction to our consumers. 4. It affords a very smooth passage for the water.	We prefer the enamelled for the reasons already given.
PAWTUCKET, R. I. Edwin Darling, Sup't.	Used only when demanded by the consumer. Very small percentage of services use it. Pressure 100 and over requires very heavy pipe when used. Have had no bad results from any used as far as known.	¾ inch for services was adopted in the early stage of the Works. Think the size should have been 1 inch. Should advocate 1 inch for ordinary services. 1 inch will last longer before filling than the difference of cost proportionately.	We are using "tarred iron." Advise 1 inch in all cases. Proprietors paying the difference in cost between ¾ inch and 1 inch to street line. ¾ inch furnished and laid *free* to street line.	1 inch wrought iron coated with Dr. Smith's preparation. Prefer iron to lead for sanitary reasons and economy. Iron may be replaced every 10 years if necessary at a less cost than lead.
PLYMOUTH, MASS. R. W. Bagnell, Sup't.	I use ½ lead pipe, weight 1½ lbs. per foot with a pressure of 53 lbs. ¾ lead pipe, weight per ft. 2 lbs. ¾ " " " " " " 2½ " I never have had any bad results from pipe of this weight.	I never lay any wrought iron pipe unless it is lined with cement. I commenced to lay the cement lined service pipe about 6 years ago. Never have had any trouble with it.	I am using lead or wrought iron pipe lined with cement. I give the applicant his preference; some choose lead and some the cement lined.	For my own use I should prefer the wrought iron cement lined pipe on account of its purity and durability.
SALEM, MASS. Benjamin A. Grush, Sup't.	We use lead pipe of the following sizes and weight for connections only: ¾ inch 2½ lbs. per foot. ¾ " 3½ " " " 1 " 4½ " " " 1½ " 6½ " " " Our pressure is from 50 to 60 pounds. Have never heard of any ill effects from its use.	Galvanized Iron Pipe has always been used on these works for services since their commencement and has generally given satisfaction. We have had some few cases of filling up and rusting out.	We are using galvanized iron pipe because we think it lasts longer than any other kind of iron pipe and is cheaper than lead.	I should much prefer lead pipe for services, it being less liable to fill up and being perfectly smooth inside will furnish more water and will last longer than any other pipe in common use. Its cost is its only objection.

Reports from Members in Matter of SERVICE PIPE.

kind of service to use and your	5th. Please give any information acquired by your experience in the use of service pipe, which would be of interest to the Association.	Source of Information.	1st. LEAD PIPE. Please state sizes used by you, giving weight per foot and head in pounds pressure for each size used and also whether you have had any bad results from the use of this pipe.	2d. WROUGHT IRON PIPE. Please state the kind used and your experience with the same.	3d. Please state the kind you are now using and your reasons therefor.	4th. Please state the pipe you would prefer reasons therefor.
		SPRINGFIELD, MASS. J. C. Hancock, Sup't.	½ in. = 2 lbs. per ft. ⅝ " = 3 " " " ¾ " = 4 " " " 1 " = 6 " " " Used indiscriminately for pressures varying from 40 lbs. to 130 lbs. Have had no bad results from use of water, but in some soils have been troubled with the pipe pitting on the outside to the extent of destroying the pipe.	Cement lined. A good pipe but very difficult to get perfect and extra size adds to cost. Galvanized iron. Worthless, rusts worse than plain iron. Rubber coated. Soon becomes worthless as a protection. Enamelled iron. Very little protection; soon rusts. Tarred iron. Have had very little or no trouble from it.	Except between corporation and stop, tarred iron, on account of its lowest first cost.	Tarred iron of a size suf for the incrustation for a s years except upon business if the soil would allow, wo
d for the reasons	This question I have answered in replying to previous questions.	ST. ALBANS, VERMONT. Marshall Mason, Sup't.	Never have used lead pipes.	At the first, twelve years ago, we used wrought iron cement lined, which I think, when good material is used and good work done, is one of the best kind of service pipes used. In several thousand feet none have failed.	We are using galvanized iron. Chiefly because it is easily handled and subject to few conditions in laying successfully. Our limited experience with it in point of time has developed nothing very objectionable in it.	I would like well made wrought iron cement lined.
oated with Dr. sanitary reasons very 10 years if an lead.	Experience in the use of service pipes is satisfactory as advised in the answers to the foregoing questions. Think small pipe (⅝ inch) is poor economy.	ST. JOHNS, NEW BRUNSWICK. Gilbert Murdoch, Sup't. Sewerage & Water Works.	Our lead service pipes vary in size from ½ to 1 inch, inside diameters; and our weights and pressures are about as follows, viz.: Diameter. Weight per ft. Extreme pres ½ in. about 2 lbs. 70 lbs. ⅝ " " 2½ " 70 " ¾ " " 3 " 70 " 1 " " 3½ " 70 " Sizes most commonly used ½ inch and ¾ of an inch. No bad results whatever.	When our works were started (1838) ¾ in. common wrought iron and 1½ inch cast iron pipe were used for house service but in 1852 both had become so troublesome and unsatisfactory that their further use was abandoned. The wrought iron rusted out rapidly and both had their areas reduced to such an extent by incrustation as to make them practically useless, and compel renewal. We have not had any extended experience with galvanized pipe, but from what we have had, would not advise its use for ordinary house services. We have a few 1½ inch, 2 inch and 3 inch galvanized wrought iron services in use for trade purposes and for this duty they appear to answer pretty well, but our experience is insufficient to warrant an opinion as to their durability, &c.	Since 1852 we have used lead only, for house services. We prefer it to wrought iron as it is more pliable, more easily laid, more durable, more easily repaired, when damaged by frost or otherwise, and retains, practically, its original water area for untold years. Such, at least, is our experience.	For the reasons given ab lead for service piping to a rial known to us at present.
uld prefer the pipe on account .	I know of service pipes in town ⅝ of an inch with a pressure of 50 lbs. that were laid when the works were built in 1855, made of tin, lined and covered with cement, that have never required any repairs and to all appearance as good to-day as when laid.	TAUNTON, MASS. Wm. R. Billings, Sup't.	¾ in. 4½ lbs. per ft. for all heads. 1 " 6 " " " " " " The pressure upon our service pipes varies from 25 to 125 lbs. per sq. inch (not including the effect of water ram).	Cement lined. Gives entire satisfaction when couplings are carefully lined with cement. We use enamelled fittings.	Each service is made up of 1½ ft. of lead pipe with the remainder cement lined wrought iron with enamelled fittings.	Lead. Because with our w fectly healthful, is the most the easiest to manipulate.
d pipe for ser- to fill up and de will furnish nger than any Its cost is its		WALTHAM, MASS. W. C. Wilcox, Clerk.	Do not use lead except for connections.	We use 1 inch lined down to ¾ inch with cement. Our experience is that it makes a perfect pipe.	Wrought iron cement lined. Our reasons therefor are that it forms no rust, and sediment does not adhere to it. We know of no pipe that is better.	Wrought iron, cement lined, stated above

WROUGHT IRON PIPE. Please state kind used and your experience with ame.	3d. Please state the kind you are now using and your reasons therefor.	4th. Please state the kind of service pipe you would prefer to use and your reasons therefor.	5th. Please give any information acquired by your experience in the use of service pipe, which would be of interest to the Association.	Source of Information.	1st. LEAD PIPE. Please state sizes used by you, giving weight per foot and head in pounds pressure for each size used and also whether you have had any bad results from the use of this pipe.
have used wrought iron pipes, plain d and galvanized pipe.	Are using tarred pipe, size 1 inch for service.			SPRINGFIELD, MASS. J. C. Hancock, Sup't.	½ in. = 2 lbs. per ft. ⅝ " = 3 " " " ¾ " = 4 " " " 1 " = 6 " " " Used indiscriminately for pressures varying from 40 lbs. to 130 lbs. Have had no bad results from use of water, but in some soils have been troubled with the pipe pitting on the outside to the extent of destroying the pipe.
Commissioners began with the ce- lined, wrought iron pipe. One inch lined down to ¾ inch. In some in- s the lining became disconnected, bstructed the water flow, and also at the joints. We tried rubber- , but the coating came off. We ar-coated, but it gave a bad taste to ater for some time. For the past years we have used the enamelled, ntire satisfaction.	The enamelled pipe. 1. It gives no taste to the water. 2. It resists rust better than any we have tried. 3. It gives entire satisfaction to our consumers. 4. It affords a very smooth passage for the water.	We prefer the enamelled for the reasons already given.	This question I have answered in replying to previous questions.	ST. ALBANS, VERMONT. Marshall Mason, Sup't.	Never have used lead pipes.
h for services was adopted in the age of the Works. Think the size have been 1 inch. Should advocate for ordinary services. 1 inch will ger before filling than the differ- cost proportionately.	We are using "tarred iron." Advise 1 inch in all cases. Proprietors paying the difference in cost between ¾ inch and 1 inch to street line. ¾ inch furnished and laid *free* to street line.	1 inch wrought iron coated with Dr. Smith's preparation. Prefer iron to lead for sanitary reasons and economy. Iron may be replaced every 10 years if necessary at a less cost than lead.	Experience in the use of service pipes is satisfactory as advised in the answers to the foregoing questions. Think small pipe (¾ inch) is poor economy.	ST. JOHNS, NEW BRUNSWICK. Gilbert Murdoch, Sup't. Sewerage & Water Works.	Our lead service pipes vary in size from ½ to 1 inch, inside diameters; and our weights and pressures are about as follows, viz.: Diameter. Weight per ft. Extreme pres ½ in. about 2 lbs. 70 lbs. ⅝ " " 2½ " 70 " ¾ " " 3 " 70 " 1 " " 3½ " 70 " Sizes most commonly used ½ inch and of an inch. No bad results whatever.
r lay any wrought iron pipe unless d with cement. I commenced to ement lined service pipe about 6 o. Never have had any trouble	I am using lead or wrought iron pipe lined with cement. I give the applicant his preference; some choose lead and some the cement lined.	For my own use I should prefer the wrought iron cement lined pipe on account of its purity and durability.	I know of service pipes in town ¾ of an inch with a pressure of 50 lbs. that were laid when the works were built in 1855, made of tin, lined and covered with cement, that have never required any repairs and to all appearance as good to-day as when laid.	TAUNTON, MASS. Wm. R. Billings, Sup't.	¾ in. 4½ lbs. per ft. for all heads. 1 " 6 " " " " " " The pressure upon our service pipes varies from 25 to 125 lbs. per sq. inch (not including the effect of water ram).
zed Iron Pipe has always been these works for services since mencement and has generally sfaction. We have had some of filling up and rusting out.	We are using galvanized iron pipe because we think it lasts longer than any other kind of iron pipe and is cheaper than lead.	I should much prefer lead pipe for services, it being less liable to fill up and being perfectly smooth inside will furnish more water and will last longer than any other pipe in common use. Its cost is its only objection.		WALTHAM, MASS. W. C. Wilcox, Clerk.	Do not use lead except for connections.

ts from Members in Matter of SERVICE PIPE.

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pressures Have had er, but in with the the extent	Cement lined. A good pipe but very difficult to get perfect and extra size adds to cost. Galvanized iron. Worthless, rusts worse than plain iron. Rubber coated. Soon becomes worthless as a protection. Enamelled iron. Very little protection; soon rusts. Tarred iron. Have had very little or no trouble from it.	Except between corporation and stop, tarred iron, on account of its lowest first cost.	Tarred iron of a size sufficient to allow for the incrustation for a score or more of years except upon business streets, where if the soil would allow, would prefer lead.	
	At the first, twelve years ago, we used wrought iron cement lined, which I think, when good material is used and good work done, is one of the best kind of service pipes used. In several thousand feet none have failed.	We are using galvanized iron. Chiefly because it is easily handled and subject to few conditions in laying successfully. Our limited experience with it in point of time has developed nothing very objectionable in it.	I would like well made and well laid wrought iron cement lined.	
size from and our ut as fol- reme pres 70 lbs. 70 " 70 " nch and tever.	When our works were started (1838) ¾ in. common wrought iron and 1½ inch cast iron pipe were used for house service but in 1852 both had become so troublesome and unsatisfactory that their further use was abandoned. The wrought iron rusted out rapidly and both had their areas reduced to such an extent by incrustation as to make them practically useless, and compel renewal. We have not had any extended experience with galvanized pipe, but from what we have had, would not advise its use for ordinary house services. We have a few 1½ inch, 2 inch and 3 inch galvanized wrought iron services in use for trade purposes and for this duty they appear to answer pretty well, but our experience is insufficient to warrant an opinion as to their durability, &c.	Since 1852 we have used lead only, for house services. We prefer it to wrought iron as it is more pliable, more easily laid, more durable, more easily repaired, when damaged by frost or otherwise, and retains, practically, its original water area for untold years. Such, at least, is our experience.	For the reasons given above, we prefer lead for service piping to all other material known to us at present.	Nothing occurs to us at present of a novel character in connection with service piping that could be of special interest to the Association. We have found lead pipe subject to external decay when in contact with some of our slate and limestone rocks, but not to any serious extent. We were tempted once to try tin-lined lead pipe, but a short experience convinced us of our error. It lacked strength and durability. Our supply is constant day and night; and need I say that the hyper-scientific bugbear of lead poisoning has no influence on our medical men or water takers. Our local sanitarians and temperance orators are much more concerned for the safety of the men who wont drink cold water without a "stick in it" than for such as drink it copiously, without mixture, from a good old-fashioned lead pipe. And justly so.
ads. " ice pipes inch (not n).	Cement lined. Gives entire satisfaction when couplings are carefully lined with cement. We use enamelled fittings.	Each service is made up of 1½ ft. of lead pipe with the remainder cement lined wrought iron with enamelled fittings.	Lead. Because with our water it is perfectly healthful, is the most durable, and the easiest to manipulate.	For any work to be put under ground first cost is, or should be, a secondary consideration. The best that can be got is the cheapest in the end.
nections.	We use 1 inch lined down to ¾ inch with cement. Our experience is that it makes a perfect pipe.	Wrought iron cement lined. Our reasons therefor are that it forms no rust, and sediment does not adhere to it. We know of no pipe that is better.	Wrought iron, cement lined, for reasons stated above	We have used some wrought iron tarred, but have had much trouble with the tar coming off.

Source of Information.	1st. LEAD PIPE. Please state sizes used by you, giving weight per foot and head in pounds pressure for each size used and also whether you have had any bad results from the use of this pipe.	2d. WROUGHT IRON PIPE. Please state the kind used and your experience with the same.	3d. Please state the kind you are now using and your reasons therefor.	4th. Please state the kind of service pipe you would prefer to use and your reasons therefor.
WILMINGTON, N. C. John C. Chase, Sup't.	Have never used it except for lead connections at main. Use here for that purpose : ¾ in. 2 lbs. 12 oz. Do not vary weight for ¾ " 3 " 8 " head which runs from 1 " 4 " 12 " 30 lbs. minimum do- 1¼ " 5 " 12 " mestic to 130 maximum fire pressure.	Have used cement lined, tarred, enamelled, and rubber coated, also galvanized to slight extent. Enamelled has given the best satisfaction as I have used them.	Have used here enamelled from ½ inch to 1½ inch and tarred for 2 inches until lately when I have used 1¼ inch to 2 inches galvanized and shall use the same in the smaller sizes when my present stock is exhausted. I find in my three years' experience here that the galvanized stands in our water as well as the enamelled, and the change is made on the score of expense as it will make a saving of at least $1 per service.	I consider the cement lined when well and properly laid (as described and practised by Mr. Richards of New London), as the best by far, and hope to get around to its use in time, but have not the skilled help at present and could not give the personal supervision necessary to secure a good job. In cities where the streets are encumbered with sewers, drains, &c.. and where it would be hard to get a direct line, should prefer lead, and in fact consider it superior to the iron pipes. Its cost would bar its use here.
WINCHESTER, MASS. Wm. T. Dotten, Sup't.	We use no lead for service pipe.	We first used rubber lined. The ¾ inch filled up with rust in about 8 years, and we are now taking it out. The black enamelled we have used has been no better.	We are now using cement lined 1 in. pipe, which we line ourselves to ¾ in. It will not corrode, can injure the water in no way and is the most satisfactory to consumers.	I should prefer to use lead pipe on account of ease of handling and its durability. In examining lead pipe used with our water for 10 years no sign of corrosion can be found, and I therefore think it perfectly safe.
WORCESTER, MASS. Lucian A. Taylor, Water Commissioner.	Only connections 18 inches or 20 inches long at the main used. We use ¾ inch and 1 inch. For ¾ inch weight 3½ and 4½ lbs. per ft. The former was for our low service supply. Pressure 60 to 85 lbs. The heavier weight for our high service supply, pressure say 130 to 170 lbs. For 1 inch pipe we use 6 lbs. per foot for low service.	Are now using cement lined. Some 18 or 20 years ago quite a good many galvanized pipes were used. With the exception of a very few, these have filled with rust and have been replaced with cement lined. The remainder will follow very soon.	Wrought iron cement lined. For the reasons: First, it is certainly durable. Has been in use in this city say 19 years and is good now. Second, It is very clean, no taste and no rust. Third, It is very cheap. Our 1 inch pipe lined down to ¾ inch, the ordinary size, costs ready to lay 8 cents per foot. The 1¼ inch lined down to 1 inch costs between 11 and 12 cents per foot. No cement is used on the outside of the pipe for a coating.	Wrought iron cement lined, for the reasons stated above.
NEWTON, MASS., by H. N. Hyde, Jr., Sup't.		Have used tarred iron pipe for several years and from experience I find that it will need removing in from 8 to 12 years in our water; that pipe coated with Angus Smith's process will last much longer than with any other; that it rusts much quicker where it is run through cellars if hung up on floor timbers. We use a lead connection about three feet long from the corporation cock at the main. Weights run as follows: 1 in. pipe 6 lbs. to ft.; ¾ in. 4 lbs.; ½ in. 3 lbs.; ¾ in. 2½ lbs.; on pressure of 75 to 90 lbs.	Now using enamelled iron pipe. Ordered by the Water Board; find that the enamel easily breaks off where the pipe is bent or where pipe is cut will rust as soon as pipe coated with tar.	Would prefer to use lead pipe for the reason that it never needs renewing and that it works well in our water.
NEW HAVEN, CONN. Sherman E. Grannis, Sup't.	We use no lead except for connections.	Galvanized iron is the only kind in general use here, and although it rusts up after 12 or 15 years' use I know of nothing better except cement lined.	Galvanized iron. Our works are private and the services are paid for by the consumers, and to them the plumbers recommend galvanized in preference to all others.	Have had no experience with any other and know of no better.

Reports from Members in Matter of SERVICE PIPE.

d of service se and your	5th. Please give any information acquired by your experience in the use of service pipe, which would be of interest to the Association.	Source of Information.	1st. LEAD PIPE. Please state sizes used by you, giving weight per foot and head in pounds pressure for each size used and also whether you have had any bad results from the use of this pipe.	2d. WROUGHT IRON PIPE. Please state the kind used and your experience with the same.	3d. Please state the kind you are now using and your reasons therefor.	4th. Pease state the kind of pipe you would prefer to use a reasons therefor.
d when well ed and prac- London), as t around to the skilled ot give the y to secure a are encum- . and where direct line, consider it cost would	I think of nothing now in answer to your fifth query.	QUINCY, MASS. Frank E. Hall, Sup't.	⅝ in. 3½ lbs. ¾ in. 4½ lbs. Pressure 90 lbs.	Tar coated. In use one year.	Wrought iron, tar coated, and lead.	Lead, or cement lined wrough with preference for lead. Conside most durable and economical.
pipe on ac- d its dura- used with f corrosion re think it	Kyonized spruce boxes of 1 in. stuff show no sign of decay after 10 years' use.	NEW BRITAIN, CONN. Arthur W. Rice, Commissioner.	Use no lead except for connections.	Generally plain wrought iron, though we have some galvanized iron. We once used cement lined iron, but have abandoned them. Our experience with wrought iron is generally satisfactory.		We prefer galvanized iron.
or the rea-	Formerly some tin lined lead pipe was used. This did not give good results and has been replaced. This season there have been two cases of leaks in cement lined pipe occasioned by corrosion from the outside. One case was where the pipe was laid through a filling of coal ashes, cinders and rubbish; the other where the pipe was exposed to sewage passing through or in close proximity to a cesspool. Undoubtedly in some localities it would be necessary in using wrought iron pipe to coat with cement on the outside. Thus far in this city it has not seemed necessary.	BIRMINGHAM, CONN. Daniel S. Brinsmade, Sup't.	Our Corporation has nothing to do with putting in the service pipes. Galvanized iron is generally used and there is no complaint.			
pe for the wing and	Of all the different kinds of coated iron pipes, galvanized iron lasts the longest with us.					
any other		NORWICH, CONN. Junius A. Brand, Sup't.		Wrought iron cement lined pipe is used here and in my opinion it is a failure. In laying it is liable to be strained, thereby breaking the cement, which will invite corrosion and obstruction in a short time; there is also a liability of imperfection in lining. Corrosion also takes place at every coupling and particularly at the ends of the pipe. I have used brass couplings, but they become filled with the rust from the ends of the pipe.	Wrought iron pipe, cement lined, by order of Water Commissioners. They are now seriously considering the introduction of lead.	I would prefer brass, but tha count of cost being out of the qu would put in lead, on account of bility and the little trouble requ take care of it. In this city obse extending over 17 years have demo that our water has little if any a lead as regards taking it in solutio

Wrought Iron Pipe. Please state kind used and your experience with same.	3d. Please state the kind you are now using and your reasons therefor.	4th. Please state the kind of service pipe you would prefer to use and your reasons therefor.	5th. Please give any information acquired by your experience in the use of service pipe, which would be of interest to the Association.	Source of Information.	1st. Lead Pipe. Please state sizes used by you, giving weight per foot and head in pounds pressure for each size used and also whether you have had any bad results from the use of this pipe.
ve used cement lined, tarred, enam-, and rubber coated, also galvanized ght extent. Enamelled has given the satisfaction as I have used them.	Have used here enamelled from ¼ inch to 1¼ inch and tarred for 2 inches until lately when I have used 1¼ inch to 2 inches galvanized and shall use the same in the smaller sizes when my present stock is exhausted. I find in my three years' experience here that the galvanized stands in our water as well as the enamelled, and the change is made on the score of expense as it will make a saving of at least $1 per service.	I consider the cement lined when well and properly laid (as described and practised by Mr. Richards of New London), as the best by far, and hope to get around to its use in time, but have not the skilled help at present and could not give the personal supervision necessary to secure a good job. In cities where the streets are encumbered with sewers, drains, &c.. and where it would be hard to get a direct line, should prefer lead, and in fact consider it superior to the iron pipes. Its cost would bar its use here.	I think of nothing now in answer to your fifth query.	Quincy, Mass. Frank E. Hall, Sup't.	⅜ in. 3½ lbs. ¾ in. 4½ lbs. Pressure 90 lbs.
e first used rubber lined. The ¾ inch up with rust in about 8 years, and re now taking it out. The black en-led we have used has been no better.	We are now using cement lined 1 in. pipe, which we line ourselves to ¾ in. It will not corrode, can injure the water in no way and is the most satisfactory to consumers.	I should prefer to use lead pipe on account of ease of handling and its durability. In examining lead pipe used with our water for 10 years no sign of corrosion can be found, and I therefore think it perfectly safe.	Kyonized spruce boxes of 1 in. stuff show no sign of decay after 10 years' use.	New Britain, Conn. Arthur W. Rice, Commissioner.	Use no lead except for connections.
e now using cement lined. Some 18 years ago quite a good many galvan-pipes were used. With the exception very few, these have filled with rust have been replaced with cement lined. remainder will follow very soon.	Wrought iron cement lined. For the reasons: First, it is certainly durable. Has been in use in this city say 19 years and is good now. Second, It is very clean, no taste and no rust. Third, It is very cheap. Our 1 inch pipe lined down to ¾ inch, the ordinary size, costs ready to lay 8 cents per foot. The 1¼ inch lined down to 1 inch costs between 11 and 12 cents per foot. No cement is used on the outside of the pipe for a coating.	Wrought iron cement lined, for the reasons stated above.	Formerly some tin lined lead pipe was used. This did not give good results and has been replaced. This season there have been two cases of leaks in cement lined pipe occasioned by corrosion from the outside. One case was where the pipe was laid through a filling of coal ashes, cinders and rubbish; the other where the pipe was exposed to sewage passing through or in close proximity to a cesspool. Undoubtedly in some localities it would be necessary in using wrought iron pipe to coat with cement on the outside. Thus far in this city it has not seemed necessary.	Birmingham, Conn. Daniel S. Brinsmade, Sup't.	Our Corporation has nothing to do with putting in the service pipes. Galvanized iron is generally used and there is no complaint.
ave used tarred iron pipe for several s and from experience I find that it need removing in from 8 to 12 years in water; that pipe coated with Angus th's process will last much longer than any other; that it rusts much quicker re it is run through cellars if hung up oor timbers. e use a lead connection about three long from the corporation cock at the n. Weights run as follows: 1 in. pipe to ft.; ¾ in. 4 lbs.; ¾ in. 3 lbs.; ½ in. s.; on pressure of 75 to 90 lbs.	Now using enamelled iron pipe. Ordered by the Water Board; find that the enamel easily breaks off where the pipe is bent or where pipe is cut will rust as soon as pipe coated with tar.	Would prefer to use lead pipe for the reason that it never needs renewing and that it works well in our water.	Of all the different kinds of coated iron pipes, galvanized iron lasts the longest with us.	Norwich, Conn. Junius A. Brand, Sup't.	
lvanized iron is the only kind in gen-use here, and although it rusts up 12 or 15 years' use I know of nothing r except cement lined.	Galvanized iron. Our works are private and the services are paid for by the consumers, and to them the plumbers recommend galvanized in preference to all others.	Have had no experience with any other and know of no better.			

s from Members in Matter of SERVICE PIPE.

izes used d head in used and d results	2d. WROUGHT IRON PIPE. Please state the kind used and your experience with the same.	3d. Please state the kind you are now using and your reasons therefor.	4th. Pease state the kind of service pipe you would prefer to use and your reasons therefor.	5th. Please give any information acquired by your experience in the use of service pipe, which would be of interest to the Association.
re 90 lbs.	Tar coated. In use one year.	Wrought iron, tar coated, and lead.	Lead, or cement lined wrought iron, with prefrence for lead. Consider it the most durable and economical.	In an experience of 18 years have never known lead pipe to fill with rust or sediment; this is also true of cement lined except where brass or composition fittings are used to connect with lead.
ons.	Generally plain wrought iron, though we have some galvanized iron. We once used cement lined iron, but have abandoned them. Our experience with wrought iron is generally satisfactory.		We prefer galvanized iron.	
lo with vanized no com-				
	Wrought iron cement lined pipe is used here and in my opinion it is a failure. In laying it is liable to be strained, thereby breaking the cement, which will invite corrosion and obstruction in a short time; there is also a liability of imperfection in lining. Corrosion also takes place at every coupling and particularly at the ends of the pipe. I have used brass couplings, but they become filled with the rust from the ends of the pipe.	Wrought iron pipe, cement lined, by order of Water Commissioners. They are now seriously considering the introduction of lead.	I would prefer brass, but that on account of cost being out of the question, I would put in lead, on account of its durability and the little trouble required to take care of it. In this city observations extending over 17 years have demonstrated that our water has little if any action on lead as regards taking it in solution.	